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USAWC ltr 12 Jun 1973

US ARMY TEST & EVALUATION COMMAND

REPORT ON USATECOM PROJECT NO. 8-3-0030-06F

PRODUCT IMPROVEMENT TEST OF BOLT ASSIST DEVICES

FOR RIFLE, CALIBER .223, AR15

REPORT NO. DPS-1120

NOVEMBER 1963

ABERDEEN PROVING GROUND

ABERDEEN PROVING GROUND, MARYLAND

U. S. ARMY HFIvins/ghw/40280
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IN REPLY REFER TO
STEAP-L3-DE

SUBJECT: Correction To Report on USATECOM Project No. 8-3-0030-06F, Product Improvement Test of Bolt Assist Devices for Rifle, Caliber .223, AR15, November 1964

TO SEE DISTRIBUTION

Paragraph 1.3, page 8, first paragraph should be changed to two paragraphs as follows:

"In Reference 1, it was concluded in comparing the AR15 and M14 rifles, that "The M14 has the advantage that manual force can be applied to the operating handle to close the bolt under adverse conditions."

It was also suggested by USAIB in USATECOM Report, 12 Dec 62, "Comparative Evaluation of M14, AR15 and AK 47 Rifles," Appendix BB, Annex B, deficiency 6, "Redesign the charging handle of the AR15 rifle so that the soldier can apply as much leverage to the AR15 rifle as can be applied to the M14 rifle for clearance of stoppages."

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ABSTRACT

Three models of charging handle bolt assist devices for the caliber .223 AR15 rifle were evaluated for effectiveness in manual extraction and bolt closure operations. A plunger-type bolt closure device was also evaluated. The devices were tested for operation under various adverse conditions, and other special tests were also conducted. Only the plunger-type bolt closing device provided an effective means for closing the bolt under adverse conditions. The modified charging handle did not provide adequate means for extraction operations under adverse conditions. It is recommended that the charging handle bolt assist device tested not be adopted.

(16) R[redacted]N USATECOM [redacted]8-3-0030-06F

(6) PRODUCT IMPROVEMENT TEST OF BOLT ASSIST DEVICES FOR RIFLE, CALIBER .223, AR15,

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CONTENTS

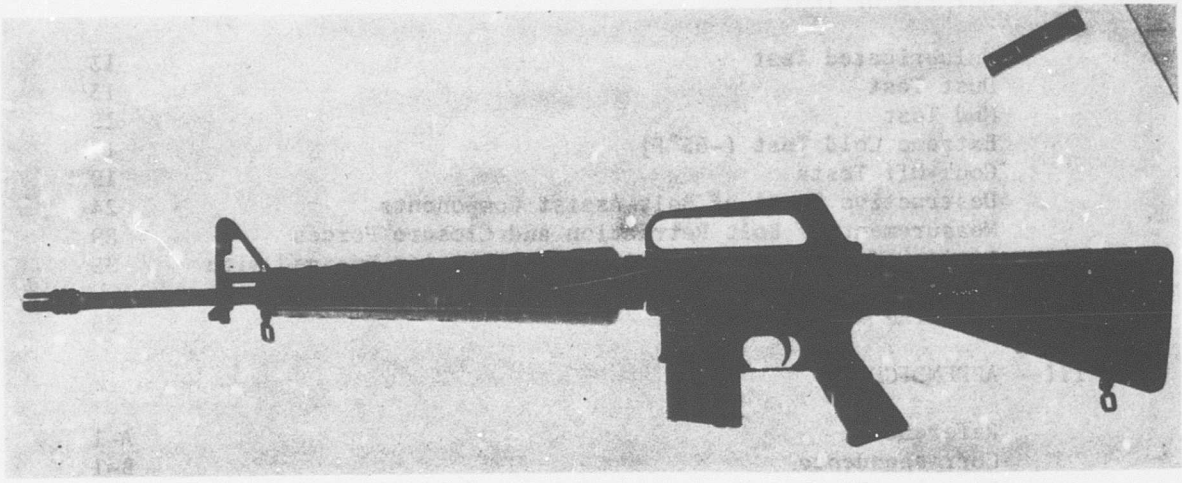

Figure 1: Rifle, Caliber .223, AR15.

DEVELOPMENT AND PROOF SERVICES

REPORT ON USATECOM PROJECT NO. 8-3-0030-06F

PRODUCT IMPROVEMENT TEST OF BOLT ASSIST DEVICES

FOR RIFLE, CALIBER .223, AR15

23 JULY TO 15 SEPTEMBER 1963

PART I - GENERAL

1.1 Authority

1.1.1 Directive. Testing was assigned by USATECOM letter, AMSTE-BC, subject: Test of Bolt Assist Device, AR15 Rifle, dated 19 July 1963. Additional testing was assigned by USATECOM in correspondence dated 24 July, 23 and 28 August, and 4, 9, and 13 September 1963 (Appendix B).

1.1.2 Purpose of Test. The AR15 rifles equipped with bolt assist devices (and standard AR15 rifles) were evaluated for:

a. Safety under normal firing and cook-off conditions.

b. Effectiveness of the charging handle bolt assist device in chambering and extraction operations and of the plunger-type device in bolt closing operations under adverse conditions.

c. Adequacy of the charging handle latches under tensile loads 25% in excess of the maximum load causing failure of the bolt carrier key plunger and the charging handle spring.

1.2 Description of Materiel

The AR15 (Figure 1) rifles equipped with the charging handle bolt assist devices were modified as follows:

a. A spring-loaded pin was incorporated in the bolt carrier key.

b. The charging handle was redesigned and the material was changed from aluminum to steel. A flat spring was incorporated at the top front of the charging handle, and a slotted hole was provided in the spring for engagement with the carrier key plunger. Figure 2 shows a redesigned charging handle and a bolt with a carrier key plunger. The first redesigned charging handle was

equipped with one latch; the second model had two latches. The third design was similar to the second except that the portions of the latch bodies protruding into the carrier key channel of the handle were removed, and the channel was lengthened slightly by removal of material at the rear end. It was reported by Lt Col Yount, AR15 Project Manager, that the object of these modifications was to eliminate interference to travel of the bolt carrier key and outward spreading of the latches in extreme rear travel of the bolt. Under these conditions the bolt carrier is to impinge on the receiver in extreme rear travel. The charging handles were also provided with a steel pad to aid in bolt closing and opening operations. The standard and the three modified charging handles are shown in Figures 3 and 4.

c. The receiver was modified by removal of material from the area under the carrying handle to accommodate a riveted steel cam plate. An external view of the cam plate is shown in Figure 5. The rifles provided with double latch charging handles had a notch cut into the right side of the receiver to accommodate the additional latch.

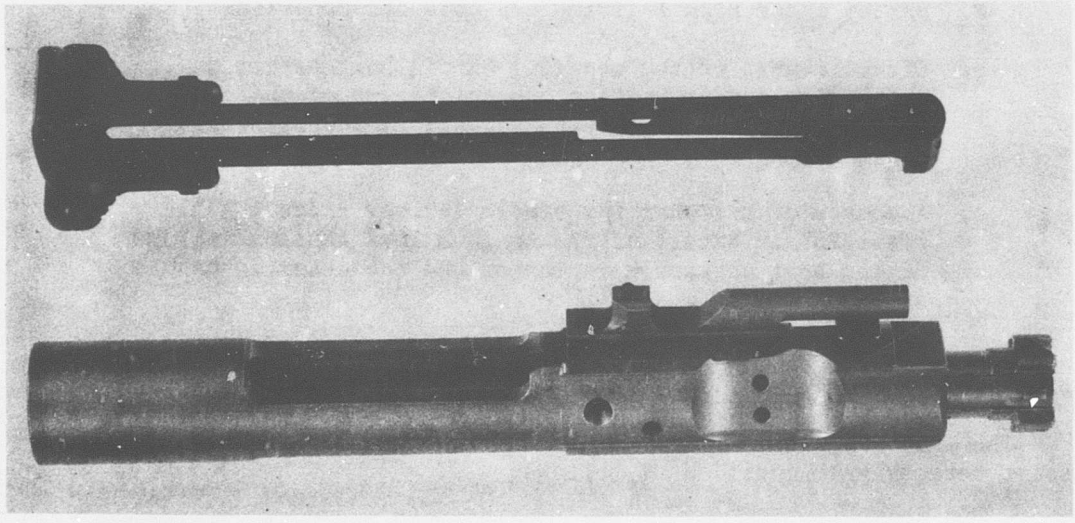

Figure 2: Redesigned Charging Handle with Two Locking Latches, Vertical Pad at Rear End, and Spring at Top Front. Note Plunger Incorporated in Bolt Carrier Key, in Line with Slotted Hole in Charging Handle Spring.

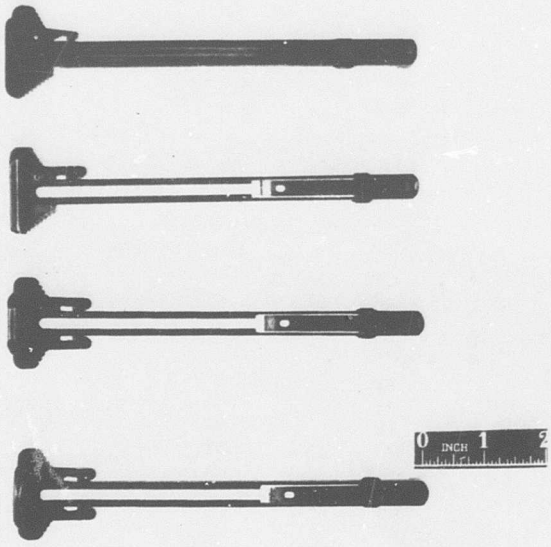

Figure 3: Charging Handle Assemblies. Top to Bottom: Standard Aluminum Model; Redesigned Steel Model with One Latch; Redesigned Steel Model with Two Latches; Redesigned Steel Model with Two Latches and Elongated Carrier Key Channel. Note Length of Channel Compared to Latch Pivot Pins.

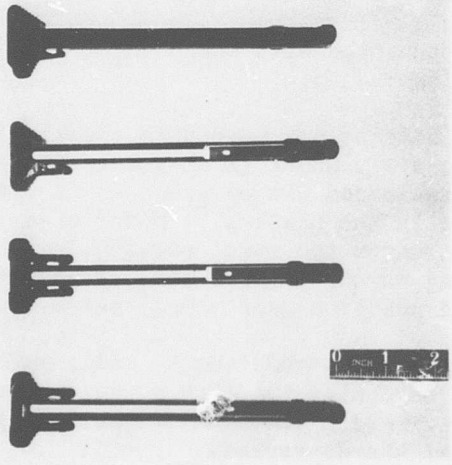

Figure 4: Charging Handle Assemblies, Upside Down View. Top to Bottom: Standard Aluminum Model; Redesigned Steel Model with One Latch; Redesigned Steel Model with Two Latches; Redesigned Steel Model with Two Latches and Elongated Carrier Key Channel. Note Length of Channel Compared to Latch Pivot Pins and Bevel at Rear of Channel.

Figure 5: Modified AR15 Rifle. Note Riveted Cam Plate under Carrying Handle and Double Latch Charging Handle with Contact Pad at Rear End to Assist in Bolt Closing and Opening Operations.

The AR15 rifles equipped with the plunger-type bolt closing device were modified as follows:

a. An aluminum housing was welded to the right side of the receiver to accommodate a plunger group consisting of the plunger head, shaft, spring-loaded hinged pawl, and shaft pin. The plunger was retained in the housing by means of a roll pin, which permitted the plunger to travel about 0.3 inch in the housing. A coil spring on the plunger shaft repositioned the plunger to the rearward position upon manual release of the plunger.

b. The bolt carrier was modified by milling 28 serrations at the right side, beginning 1.4 inches from the rear and extending 3.5 inches forward. The plunger pawl engaged a serration when the pawl was depressed.

An external view of an AR15 rifle with the plunger-type bolt closing device is shown in Figure 6. Figure 7 shows a serrated bolt and plunger group removed from the housing.

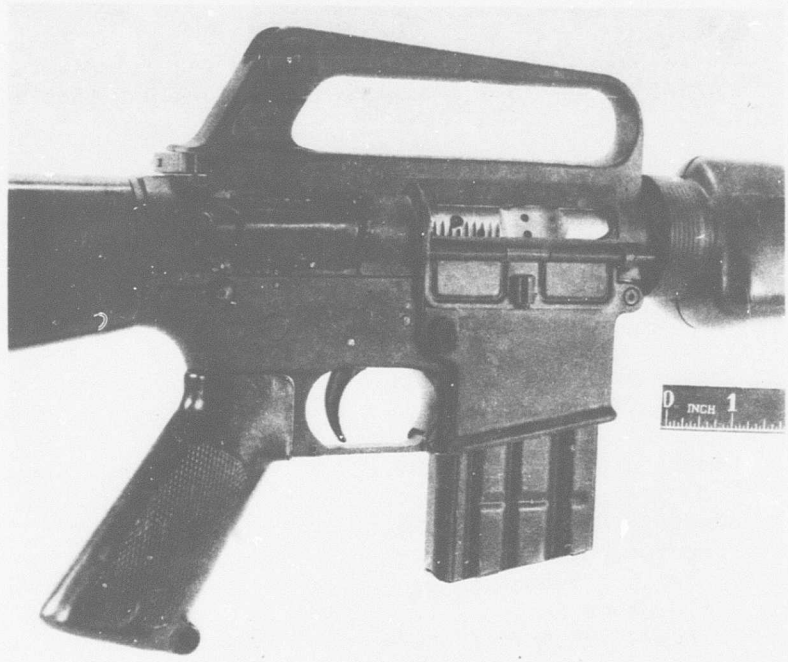

Figure 6: Rifle, AR15, with Plunger-Type Bolt Closing Device.

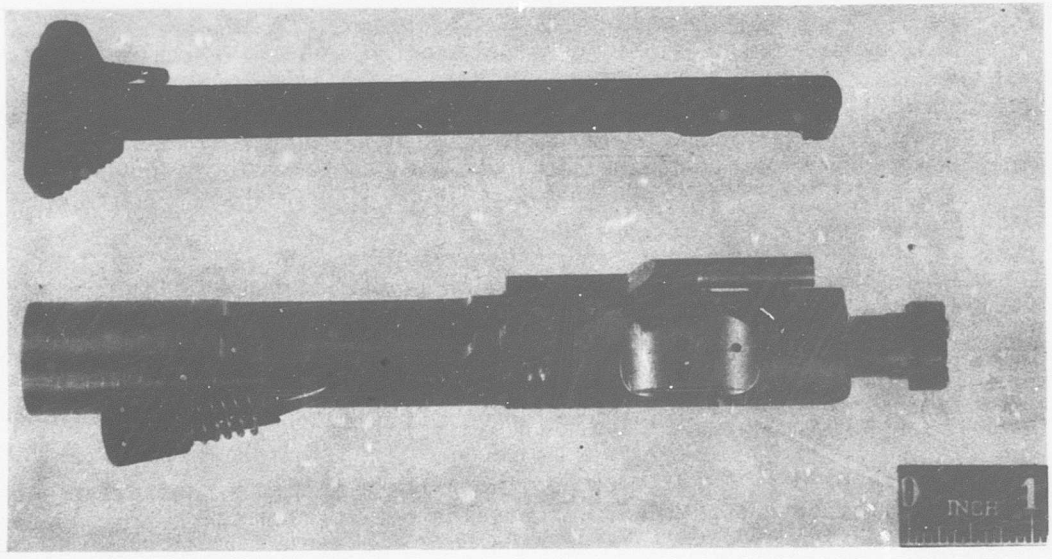

Figure 7: Standard AR15 Rifle Charging Handle and Serrated Bolt and Bolt Closing Plunger Group Removed from Receiver Housing.

Table I contains individual rifle serial numbers, modifications, and test usage.

The standard AR15 rifle is fully described and illustrated in Air Force Technical Order (TO) 11W3-5-5-1, and is identified as rifle, 5.56-mm, M16.

Table I. Rifle Identification

Rifle No.	Modification	Tests
Q08271	None.	Cook-off only.
008306	Charging handle bolt assist device, single latch.	Unlubricated, dust, mud, and cold.
011220	Charging handle bolt assist device, double latch.	Unlubricated, dust, mud, cold, destructive, and charging loads.
013060	Charging handle bolt assist device, double latch.	Unlubricated, dust, mud, cold, and destructive.
012548	Charging handle bolt assist device, double latch, and charging handle modifications.	Cook-off only.
013058	Plunger-type bolt closing device.	Unlubricated, dust, mud, and cold.
013351	Plunger-type bolt closing device.	Unlubricated, dust, mud, cold, and charging loads.
008679	None	Extractive loads only.

Ball ammunition, caliber .223, was used in all the tests. Lot Z16M was used in rifles 012548, 008306, 013058, and 013351; lot Z015M, in rifle 008271; and lot Z01M in rifles 011220 and 013060. In addition, all the ammunition was identified as RA 5024.

1.3 Background

In Reference 1, it was concluded, in comparing the AR15 and M14 rifles, that "The M14 has the advantage that manual force can be applied to the operating handle to close the bolt under adverse conditions."/ It was also suggested: "Redesign the charging handle of the AR15 rifle so that the soldier can apply as much leverage to the AR15 rifle as can be applied to the M14 rifle for clearance of stoppages."

The standard AR15 rifle is provided with a charging handle for pulling the bolt group to the rear only, depending entirely on the energy of the compressed action spring to return the bolt and strip a round from the magazine, chamber the round, and lock the bolt. Under adverse conditions (such as dust and mud), because of increased friction, the energy of the compressed driving spring is not always sufficient to accomplish these functions, thereby necessitating the incorporation of a device to manually assist closure of the bolt.

The charging handle bolt assist device was designed by Springfield Armory. The first charging handle was provided with a single latch and was designed primarily for manually assisting closure of the bolt. The second model submitted by Springfield Armory was similar except that two latches were provided and a larger vertical pad was added to the rear of the handle to improve bolt closing and opening operations. Lt Col Yount, AR15 Project Manager, submitted a rifle for test which was identical to the second Springfield Armory model except for slight elongation of the bolt carrier key channel, achieved by removal of material at the rear end. This modification was made to eliminate interference to the carrier key in extreme rear travel.

The plunger-type bolt closing device was designed by the AR15 rifle manufacturer. A standard AR15 rifle charging handle was supplied with the device.

1.4 Summary of Findings

Under adverse conditions, each of five rifles equipped with bolt assist devices was fired 60 rounds in unlubricated, dust, and mud tests and 600 rounds in a cold (-65°F) test. The following malfunctions which required the use of a bolt closing or retraction device were encountered:

a. A total of 133 failures of the bolt to close occurred; 4 in the dust test, 109 in the mud test, and 20 in the cold test.

b. A total of 248 fired cases failed to extract; 3 in the dust test, 243 in the mud test, and 2 in the cold test.

c. A total of 64 fired cases failed to eject; 1 in the dust test, 19 in the mud test, and 44 in the cold test. Forty-three of the 44 failures to eject in the cold test occurred in one rifle; 6 during rounds 300 to 400, 19 during rounds 400 to 500, and 18 during rounds 500 to 600. The rifle bolt had heavy carbon deposits.

Destructive tests of the Springfield Armory design bolt assist device components gave the following results:

a. Two early model bolt carrier key plungers failed in shear at loads of 435 and 445 pounds; two of the latest plungers failed at loads of 235 and 240 pounds.

b. Two charging handle spring tabs failed in tension under loads of 1230 and 1310 pounds.

c. Each of two double-latch charging handles was subjected to a load of 1650 pounds without failure or disengagement of the latches occurring.

The average maximum bolt retractive force exerted by five individuals, by grasping the charging handle with a thumb and forefinger, was 38 pounds. The force necessary to extract and eject deformed cartridges exceeded the

retractive capabilities in two of ten instances, and the force required to remove fired cases which failed to extract during a mud test was greater than the 38-pound capability in ten of 19 instances.

The average load applied with a Universal test machine to chamber ten cartridges damaged to various degrees was 21 pounds when applied directly to the rear of the carrier (action spring was not used) and 23 pounds when the load was applied to the plunger-type bolt closing device. The average maximum manual load applied to the plunger-type bolt closing device was 59 pounds by use of a thumb and 115 pounds by use of the heel of a hand. The average maximum manual load applied to the pad at the rear of a double latch bolt assist device was 155 pounds.

1.5 Conclusions

It is concluded that:

a. Feeding and extraction malfunctions occurred in the AR15 rifle with sufficient frequency under adverse conditions tests to make it desirable that an effective means for manually assisting the bolt in opening and closing operations be provided (ref pars. 2.2.2, 2.3.2, and 2.4.2).

b. The modified charging handle bolt assist device served as an aid in closure of the bolt under some conditions, but the device did not always position the bolt carrier sufficiently forward to permit firing to take place. In addition, on several occasions when pushing the charging handle forward, a bullet stubbed the magazine causing the charging handle to disengage from the bolt-carrier key plunger (ref pars. 2.2.3, 2.3.3, and 2.4.3).

c. The charging handle bolt assist device did not provide adequate means for extraction operations under adverse conditions (ref par. 2.3.3).

d. The plunger-type bolt closing device provided an effective means for closing the bolt in chambering operations, but the plunger head surface area is too small; discomfort is experienced when impacting the plunger with the heel of the hand in closure operations (ref par. 2.3.3).

e. Based on two cook-offs and destructive tests of charging handle bolt closing components, a latched charging handle will remain engaged with the receiver under cook-off conditions, and in the event engagement of the charging handle takes place at the time of firing, failure of the carrier key plunger will occur before the charging handle spring will fail, and the charging handle spring will fail before disengagement of the charging handle from the receiver will occur (ref pars. 2.5.3 and 2.6.3).

f. If firing takes place with the plunger bolt closing device in the depressed position, the plunger will be forced rearward but will remain in its housing and no damage to the rifle is expected to occur (ref par. 2.8.3).

1.6 Recommendation

It is recommended that the charging handle bolt assist device tested not be adopted.

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PART II - DETAILS OF TEST

2.1 Unlubricated Test

2.1.1 Procedure. Each rifle was disassembled, cleaned with dry-cleaning solvent, PS-661b, and reassembled without lubrication.

2.1.2 Results. No malfunctions occurred in firing four modified AR15 rifles (008306, 011220, 013060, and 013058) 60 rounds each in an unlubricated condition. In rifle 013351, with a plunger-type bolt-assist device, two failures to feed occurred.

2.1.3 Discussion. Cognizance should be taken that the unlubricated test consisted of 60 rounds fired under otherwise nonadverse conditions.

2.2 Dust Test

2.2.1 Procedure. Each rifle was cleaned and lubricated with MIL-L-644B oil. The rifle was fully loaded, the safety was set on safe, and the rifle dust cover was closed. The rifle was placed in the dust chamber and exposed to a dust blast for 1 minute topside up and 1 minute upside down.

The dust mixture consisted of 9 pounds of grade 0 Albany sand and 1 pound of clean silica core sand which passed 100% through a 30-mesh sieve, 80% through a 50-mesh sieve, and 3.4% through a 100-mesh sieve. The dust was poured at a rate of 5 pounds per minute through a pour hole while the blower was turned at a handle speed of 60 revolutions per minute.

2.2.2 Results. The function performance of each of three 20-round dust tests from each rifle is given in Table II.

Table II. Dust Test

Rifle No.	Test No.	Malfunctions No.	Malfunctions Type
008306 CHD	1	2	Failure to feed.
	2	7	Failure to feed.
		1	Bolt overrode base of round.
		2	Failure to extract.
		2	Failure of the bolt to close.
		1	Large leak in primer joint.
	3	1	Failure of the bolt to remain to the rear after firing the last round in the magazine.
011220 CHD	1		None.
	2		None.
	3		None.

CHD = Charging handle device.

Table II (Cont'd)

Rifle No.	Test No.	Malfunctions No.	Malfunctions Type
013060 CHD	1	1	Failure of bolt to close.
		3	Failure to feed.
		1	Failure to eject.
		1	Failure of bolt to remain to the rear after firing the last round in the magazine.
	2	1	Failure of bolt to remain to the rear after firing the last round in the magazine.
	3		None.
013058 PD	1	1	Failure of bolt to close.
		1	Failure to feed.
	2		None.
	3		None.
013351 PD	1	1	Failure to extract.
		1	Failure to feed.
	2	14	Failure to feed.
		2	Bolt overrode base of round in feeding from magazine.
	3	4	Failure to feed.
		1	Failure of bolt to remain to the rear after firing the last round in the magazine.

CHD = Charging handle device.
PD = Plunger device.

2.2.3 Discussion. As shown in Table II, one rifle was fired without any stoppages in three dust tests.

With regard to the other rifles, on two occasions the bolt carrier failed to close completely when it was necessary to assist closure of the bolt manually, by use of the charging-handle bolt-assist device. Each time the charging handle was pushed forward until latching took place; however, the bolt carrier remained about 1/16 inch to the rear of the closed position. The carrier was closed each time by the shooter, by applying pressure directly to the carrier with his thumb.

On another occasion a cartridge failed to fire because of incomplete closure of the bolt. Attempts were made to retract the round but without success until the butt of the stock was impacted on a wood board while simultaneously drawing rearward on the charging handle. In this instance, sand was deposited on the base of the case and bolt face and did not permit the bolt to close. Several attempts were made to load another round, and each time the charging handle closed and latched, but the bolt carrier remained about 1/8 inch rearward of the closed position.

One failure of the bolt to close occurred when firing a rifle equipped with a plunger-type bolt-closing device. The shooter closed the bolt by depressing the plunger head with his thumb.

Three cases which failed to extract after firing could not be removed by retraction of the bolt because of case rim shears. It was necessary to use a cleaning rod to force the cases from the chambers.

One failure to eject a fired case was removed by use of the charging handle.

2.3 Mud Test

2.3.1 Procedure. Each rifle was cleaned and lubricated with MIL-L-644B oil. The rifle was fully loaded, and safety was set on safe; the rifle dust cover was closed, and the muzzle was taped to exclude mud from the bore. The rifle was immersed completely in a standard mixture of mud for a period of 15 seconds. The mud mixture was made in the proportion of 10 pounds of red clay, 2 pounds of clean river sand, and 8 quarts of water.

2.3.2 Results. The function performance of each of three 20-round mud tests from each rifle is given in Table III.

Table III. Mud Test

Rifle No.	Test No.	Malfunctions No.	Malfunctions Type
008306 CHD	1	7	Failure to feed.
		10	Failure to extract.
		1	Failure to fire.
		1	Bolt overrode base of round in feeding from magazine.
		4	Failure of bolt to close.
	2	5	Failure to extract.
		3	Failure of bolt to close.
	3	18	Failure to eject.
		1	Failure to feed.
011220 CHD	1	1	Bolt overrode base of round in feeding from magazine.
		1	Failure to fire.
		17	Failure to extract.
		2	Failure of the bolt to close.
		3	Small leak in primer joint.
		2	Blown primer.
	2	1	Failure to feed.
		19	Failure to extract.
		9	Failure of the bolt to close.
	3	1	Failure to feed.
		19	Failure to extract.
		2	Failure to fire.
		4	Failure of the bolt to close.
		2	Small leak in primer joint.
		1	Blown primer.

CHD = Charging handle device.

Table III (Cont'd)

Rifle No.	Test No.	Malfunctions No.	Malfunctions Type
013060 CHD	1	1	Failure to feed.
		1	Failure to fire.
		19	Failure to extract.
		1	Failure of bolt to close.
		4	Small leak in primer joint.
		2	Blown primer.
	2	1	Failure to feed.
		19	Failure to extract.
		7	Failure of the bolt to close.
	3	1	Failure to eject.
		19	Failure to extract.
		9	Failure of the bolt to close.
013058 PD	1	3	Failure to feed.
		12	Failure of the bolt to close.
		19	Failure to extract.
		2	Blown primer.
	2	1	Failure to feed.
		11	Failure of the bolt to close.
		20	Failure to extract.
		3	Blown primer.
	3	1	Failure to feed.
		14	Failure of the bolt to close.
		20	Failure to extract.
		2	Failure of the bolt closing plunger to return to rear.
013351 PD	1	1	Failure to feed.
		12	Failure of the bolt to close.
		19	Failure to extract.
		8	Failure of the bolt closing plunger to return to rear.
	2	16	Failure of the bolt to close.
		20	Failure to extract.
		13	Failure of the bolt closing plunger to return to rear.
	3	1	Failure to feed.
		5	Failure of the bolt to close.
		18	Failure to extract.

CHD = Charging handle device.
PD = Plunger device.

2.3.3 Discussion. On three occasions when pushing the charging handle forward to chamber a round, the bullet stubbed the magazine and the charging handle disengaged from the bolt and latched, leaving the bolt in an open position.

In rifle 008306, a total of 15 failures to extract fired cases occurred. On 14 of the occasions, the case was extracted by repeatedly impacting the butt

of the stock on the ground and simultaneously pulling on the charging handle. In the other instance, this practice was unsuccessful until the butt of the stock was impacted on concrete; however, the stock broke. In loading another round after these occurrences, the charging handle closed and latched on seven occasions without complete closure of the bolt carrier. Each time the shooter applied pressure directly to the carrier with his thumb to obtain closure. In the same rifle, during one of the mud tests, 18 failures to eject fired cases occurred because of short recoil of the bolt. It was necessary to impact the butt of the stock on the ground and pull on the charging handle to eject the cases.

In three mud tests with each of the other two rifles with charging-handle bolt-assist devices, a total of 112 failures to extract fired cases occurred. As with the other rifle, extraction was not possible without impacting the buttstock on the ground. On 32 of those occasions, when manually assisting closure of the bolt, the charging handle latched, but the bolt carrier failed to close completely, requiring thumb pressure directly to the carrier to obtain closure. One failure to eject a fired case occurred; the charging handle was used to clear the weapon.

In three mud tests with each of the two rifles with plunger-type bolt-closing devices, a total of 116 failures to extract fired cases occurred. Each case was extracted by impacting the buttstock on the ground. On the 70 occasions the bolt failed to close, closure was obtained by use of the thumb on 31 occasions, 21 times with the heel of the hand, and 18 times by bumping the plunger head against a block of wood.

2.4 Extreme Cold Test (-65°F)

2.4.1 Procedure. Each rifle was prepared for the cold test by being disassembled, cleaned with dry-cleaning solvent, PS-661b, and lubricated with MIL-L-14107 oil. The ammunition and rifles were conditioned a minimum of 12 hours at -65°F prior to firing. Each of the five rifles was fired a total of 600 rounds in groups of 100 rounds with a 2-hour conditioning period between firings.

In addition, 500 cartridges were cycled (fed, chambered, extracted, and ejected) in each rifle at -65°F, to accomplish the number of hand charging operations required in 10,000 rounds of firing, based on the necessity of charging the first round of each magazine used.

Also, one rifle (008306) was subjected to special tests at -65°F. Water was deposited in the receiver cam-plate recess and allowed to freeze, as one means of providing engagement of the charging handle with the bolt carrier key at the time of firing. With the same objective, the cam plate recess was filled with seven fired primers.

2.4.2 Results. The function performance of each rifle subjected to 600 rounds of firing at -65°F is given in Table IV.

Table IV. Extreme Cold Test (-65°F)

Rifle No.	Malfunctions No.	Malfunctions Type
008306 CHD	8	Failure to feed.
	1	Failure of the bolt to remain to the rear after firing the last round in the magazine.
	4	Bolt overrode base of round in feeding from magazine.
	1	Failure of the bolt to close.
011220 CHD	6	Failure to feed.
	5	Bolt overrode base of round in feeding from magazine.
	43	Failure to eject.
	6	Failure of the bolt to close.
	2	Partial circumferential case rupture.
013060 CHD	4	Failure to feed.
	2	Failure of the bolt to close.
	1	Failure to extract.
	1	Small primer leak in joint.
013058 PD	29	Failure to feed.
	2	Failure of the bolt to remain to the rear after firing the last round in the magazine.
	5	Bolt overrode base of round in feeding from magazine.
	2	Failure to fire.
	1	Failure to eject.
	1	Failure to extract.
	8	Failure of the bolt to close.
013351 PD	6	Failure to feed.
	5	Bolt overrode base of round in feeding from magazine.
	2	Failure to fire.
	1	Failure of the bolt to remain to the rear after firing the last round in the magazine.
	3	Failure of the bolt to close.

CHD = Charging handle device.
PD = Plunger device.

2.4.3 Discussion. Most of the failures to feed in the extreme cold tests were attributed to failure of the magazine follower to position the top round to be properly engaged by the bolt. Also, on a number of occasions the bolt failed to completely strip and chamber the first round of a magazine. In the latter type of stoppage, feeding was manually assisted with the charging-handle bolt-closing device. Three failures to feed because the bullets stubbed the magazine were chambered by use of the plunger-type bolt-closing device.

On nine occasions, the bolt failed to close when firing the three rifles equipped with charging-handle bolt-assist devices. On the first occasion, the bolt was retracted slightly and released several times to obtain closure of the bolt. Twice efforts were unsuccessful by applying pressure directly to the carrier; the cartridges were extracted and loaded by hand. Twice the carrier was positioned fully forward by use of a stick. On four occasions, the bolt could not be closed until heavy carbon deposits were removed from the bolt.

In eleven instances, the bolt failed to close in firing the two rifles with the plunger-type bolt-closing device; in each instance the bolt was closed by use of thumb pressure on the plunger.

Ice was formed in the receiver cam plate recess to cause the charging handle to remain engaged with the bolt at the time of firing. Fired primers were later lodged in the recess for the same purpose. The results were similar. In each instance some interference to recoil occurred, but failure of the bolt carrier key plunger, charging handle spring, or charging handle latch (rifle 008306 with only one latch) did not occur. The charging handle remained latched.

The charging handles of all five rifles used in the cold tests were exercised 500 additional times to feed cartridges from magazines, and the bolt assist devices were used when required. The devices remained serviceable.

2.5 Cook-Off Tests

2.5.1 Procedure. A standard AR15 rifle (008271) and an AR15 rifle (012548) with a modified double-latch bolt-assist device (with charging handle modifications) were used in the cook-off tests.

In the tests, 160 to 180 rounds were fired automatically, in the shortest time possible, to provide sufficient heating to cause the propellant of a chambered round to cook off. The cook-off round was deformed at the neck to prevent locking of the bolt. The charging handle was placed in the latched position after chambering the cook-off round. These test preparations were made to investigate cook-offs experienced by the Infantry Board and the Air Firce, during which the charging handle moved rearward.

Prior to test, the stock of each rifle was removed and a steel butt plate was attached to the lower receiver extension to accommodate a device for possible measurement of the velocity and impact force of the rifle charging handle (Figure 8). The rifle with the steel butt plate was supported in a wooden cradle (Figure 9).

2.5.2 Results. Detailed data are given in the function reports (Appendix C). A summary of the results is contained in Table V.

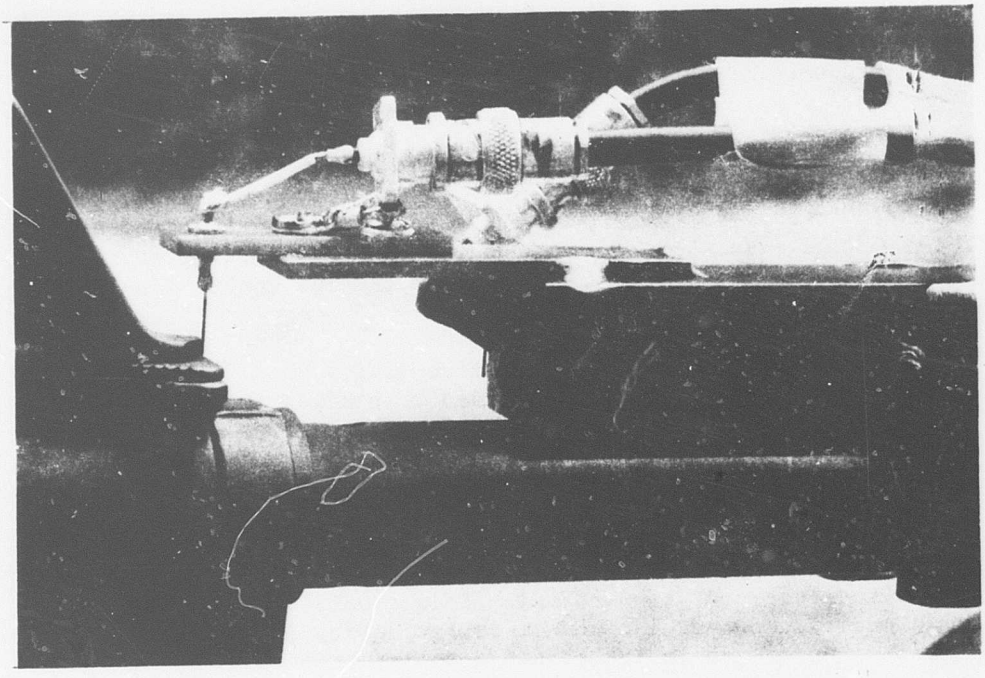

Figure 8: Device for Pickup of Velocity and Spherical Copper Pressure Crusher for Recording Impact Force of Charging Handle (if Rearward Movement Occurred during Cook-Off with Bolt in Unlocked Position). The Device Was Installed Following Firing of Gun Heating Rounds.

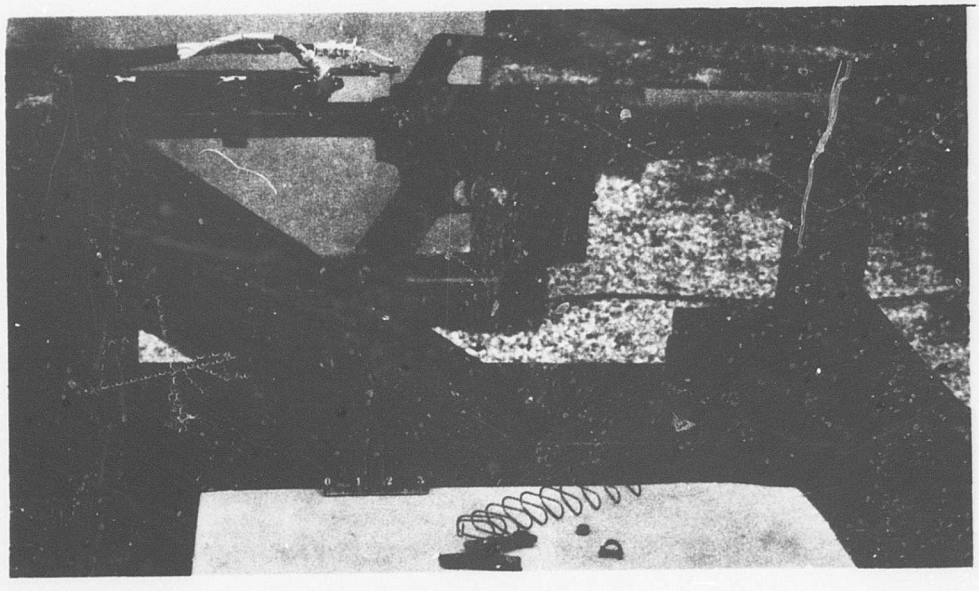

Figure 9: Standard AR15 Rifle (008271) Subjected to Cook-Off.

Table V. Cook-Off Test

Rifle No.	No. Rds Fired	Firing Time, sec	Cook-Off Time, sec
[a]008271	160	89	No cook-off
[a]008271	177	45	17
[b]012548	180	51	43

[a]Standard, AR15 rifle.
[b]Rifle, AR15, with bolt assist device (modified charging handle).

2.5.3 Discussion. Cook-off did not cause the charging handle to disengage from the receiver and move rearward in either the standard or the modified AR15 rifle.

The standard AR15 rifle upper receiver did not crack in the area below the carrying handle. All the components of the magazine except the tube were blown downward and free of the rifle. No rounds were stored in the magazine at the time of the cook-off. Figures 9, 10, and 11 show the over-all view of the rifle, the damaged bolt and undamaged charging handle, and damaged receiver, respectively.

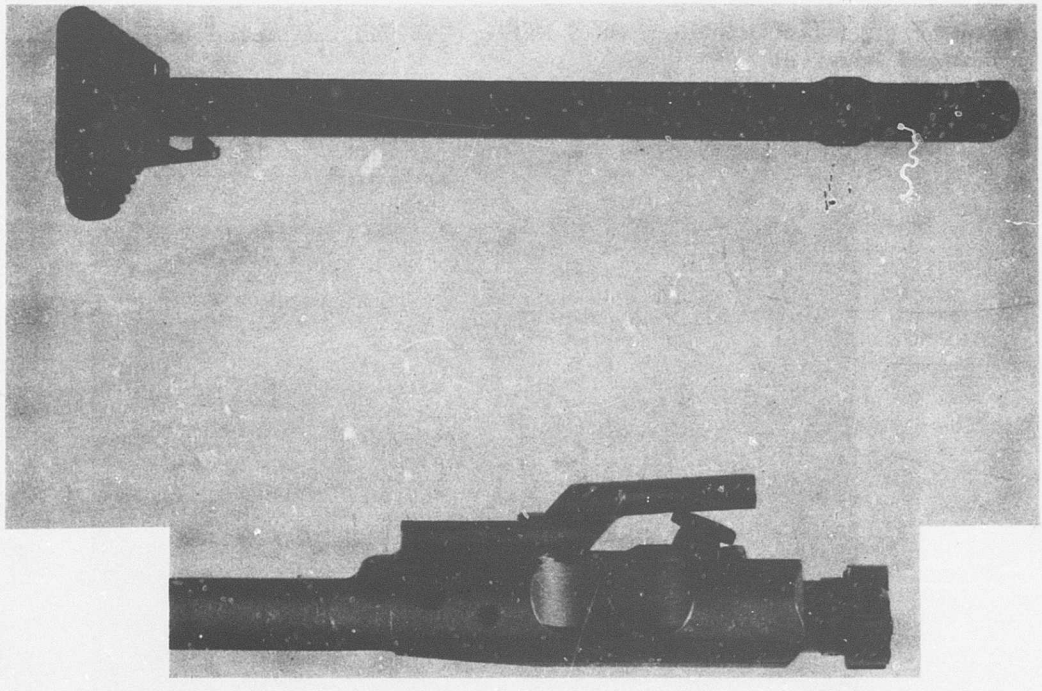

Figure 10: Damaged Bolt and Undamaged Charging Handle from Standard AR15 Rifle (008271) Subjected to Cook-Off.

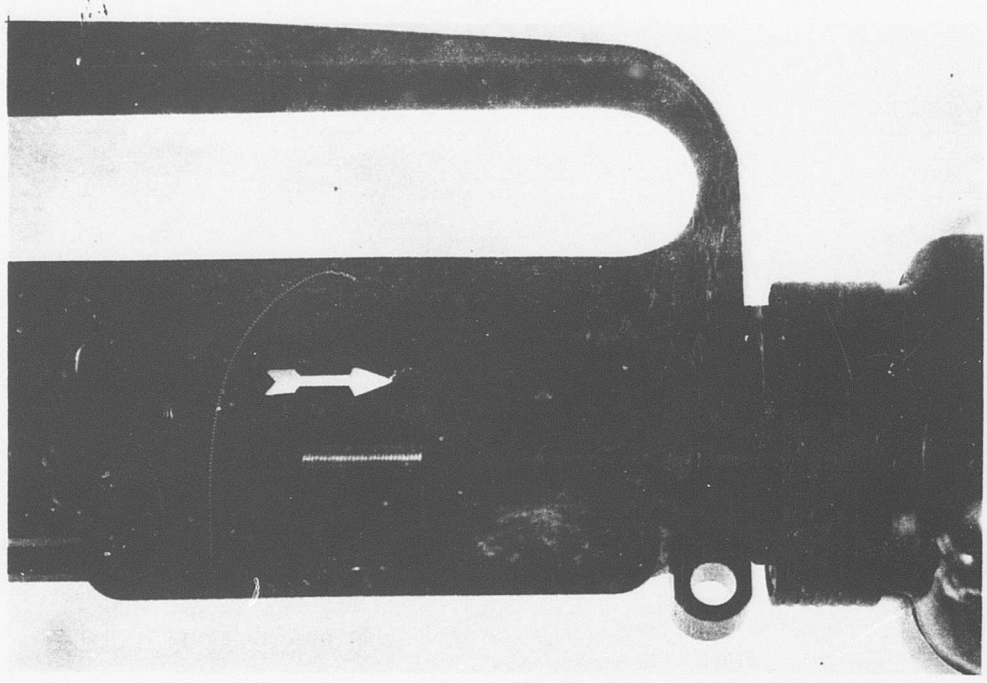

Figure 11: Standard AR15 Rifle (008271) Subjected to Cook-Off. Note Damaged Receiver.

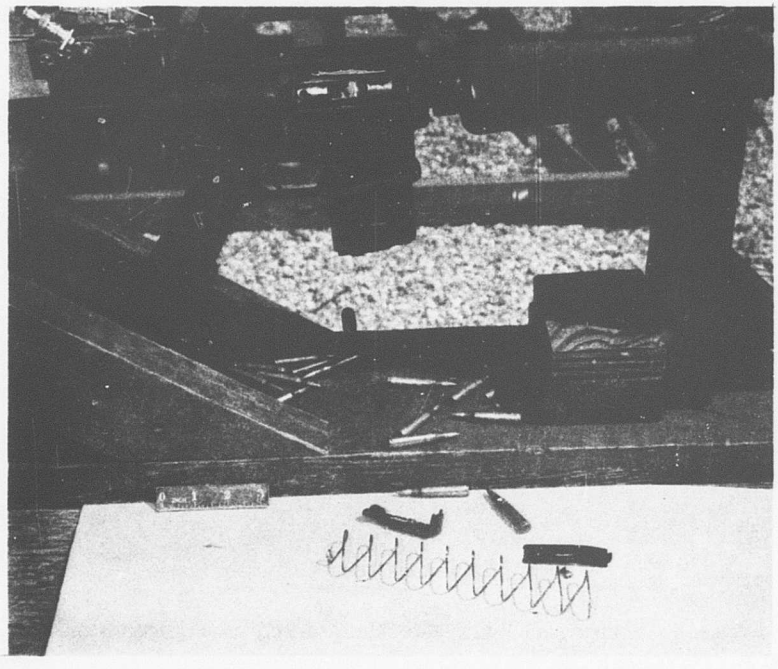

Figure 12: Rifle, AR15 (012548), with Bolt Assist Device Subjected to Cook-Off.

The receiver of the AR15 rifle with the modified charging handle was cracked forward and rearward of the riveted cam plate. All the components of the magazine, except the tube and 19 unfired rounds, were blown downward and free of the rifle. Other than slight damage at the mouth of the carrier key tube, the bolt group appeared undamaged as a result of the cook-off. Additional details on the damages are contained in Appendix C. The rifle is shown in Figure 12.

2.6 Destructive Tests of Bolt Assist Components

2.6.1 Procedure. Using a Universal test machine (Figure 13), four bolt-carrier key plungers and two charging springs were subjected to destructive tests, and the latches of two charging handles were subjected to a load 25% in excess of the maximum load required to cause a failure of a plunger or spring.

The fixtures used to shear the key plungers are shown and described in Figures 14 and 15. Each plunger was loaded to failure under conditions of an evenly increasing load; the loading rate was about 1500 pounds per minute.

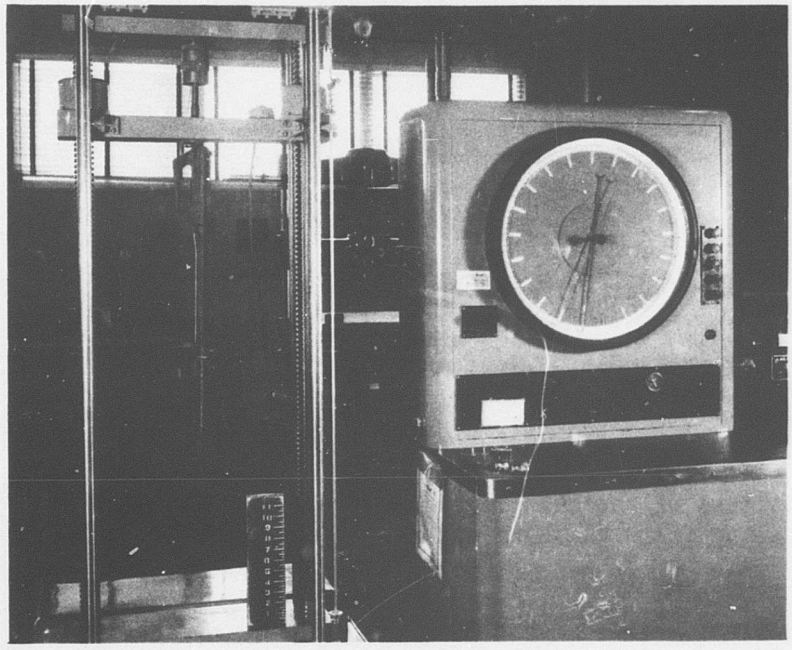

Figure 13: Universal Test Machine.

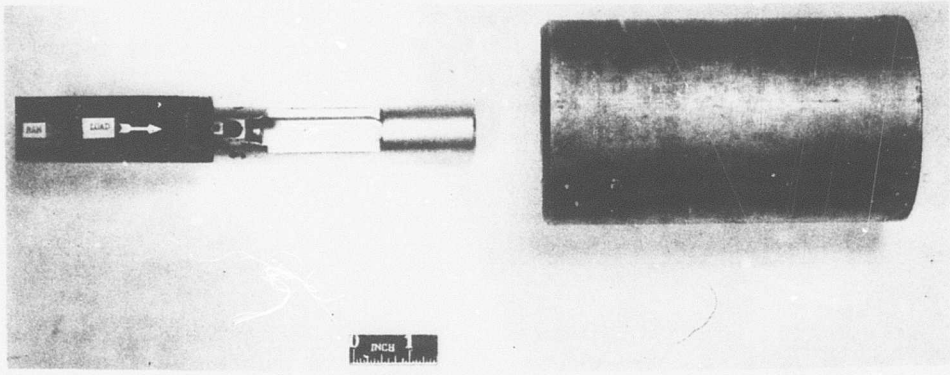

Figure 14: Test Fixtures for Shear Test of Bolt Carrier Key Plunger. Plunger Contact Area of Ram Was Shaped to Radius and Thickness of That of Charging Handle Spring.

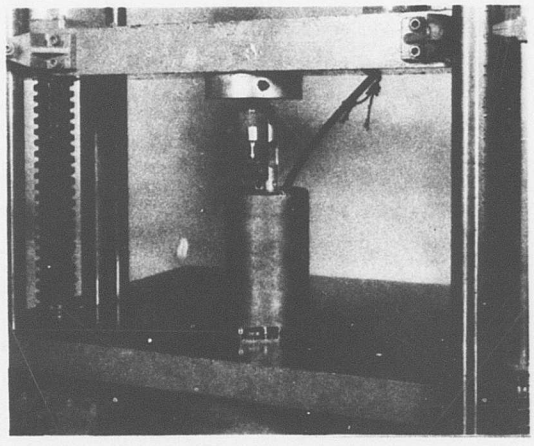

Figure 15: Bolt Carrier Key Plunger Undergoing Shear Test.

The charging handle springs were tested as illustrated and described in Figures 16 and 17. An evenly increasing tensile load was applied until failure occurred; the loading rate was approximately 1500 pounds per minute.

The latches of two charging handles were gradually loaded to 1650 pounds, using the fixtures shown and described in Figures 18 and 19.

2.6.2 Results. Results are shown in Figure 20.

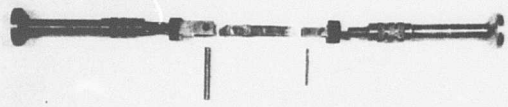

Figure 16: Parts of Test Fixture Used for Tensile Test of Charging Handle Spring. Charge Handle Was Cut Adjacent to Spring End. Pin Used in Slotted Hole Was the Diameter of Carrier Key Plunger. (A Hole Was Drilled at Hook End for Engagement in Test Fixture.)

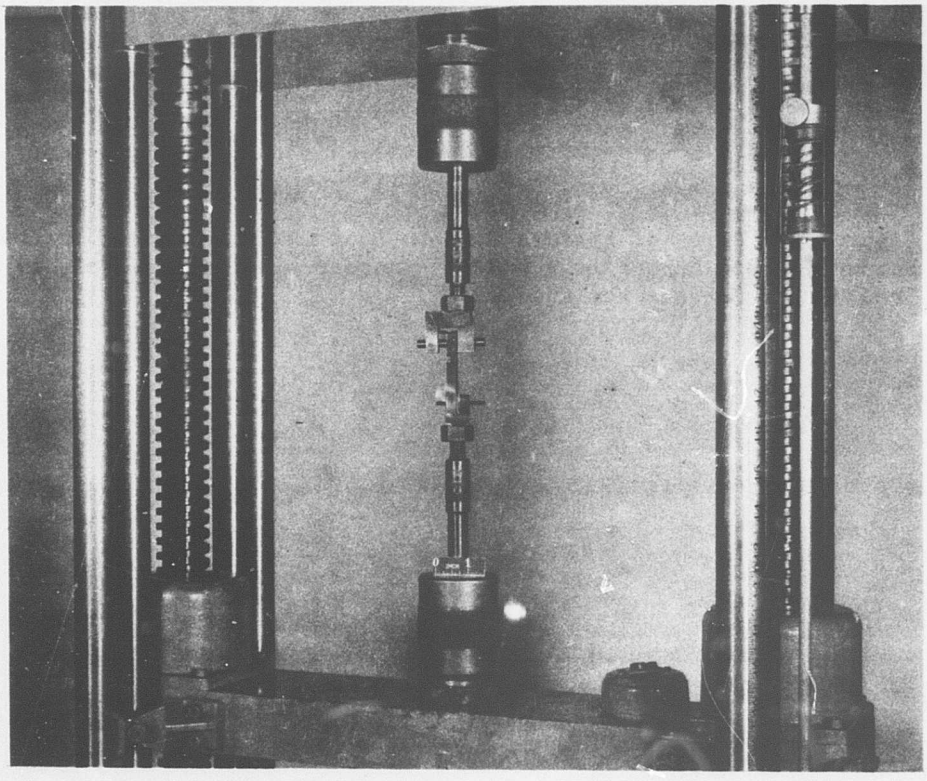

Figure 17: Testing Machine Setup for Tensile Test of Charging Handle Spring.

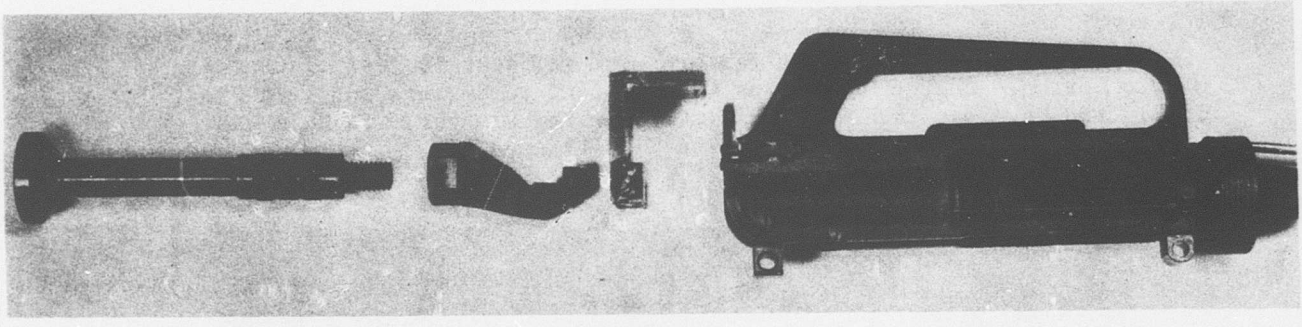

Figure 18: Parts of Fixture Used to Load Charging Handle Latches. Hook-Shaped Fixture Engaged the Charging Handle, Inside Receiver, at Rear Shoulder of Carrier Key Channel.

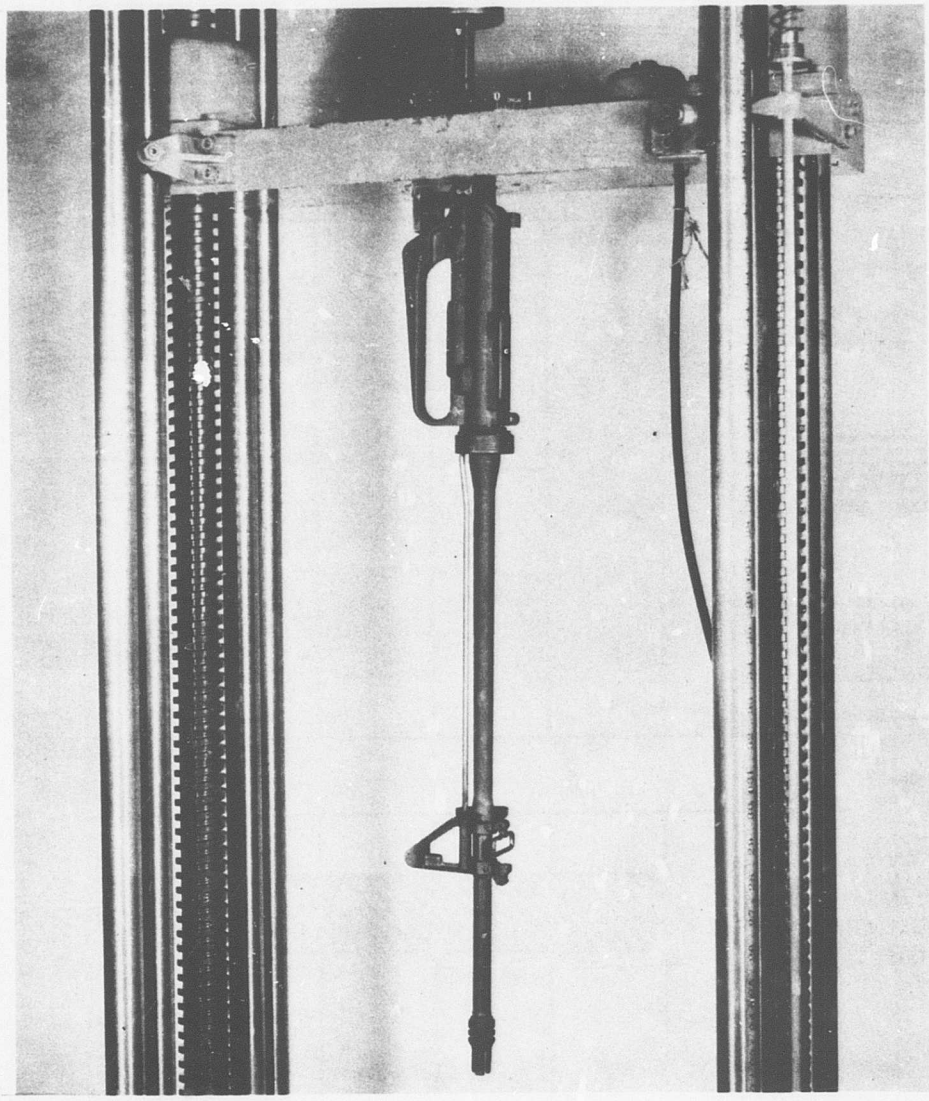

Figure 19: Testing Machine Setup for Application of Load to Charging Handle Latches.

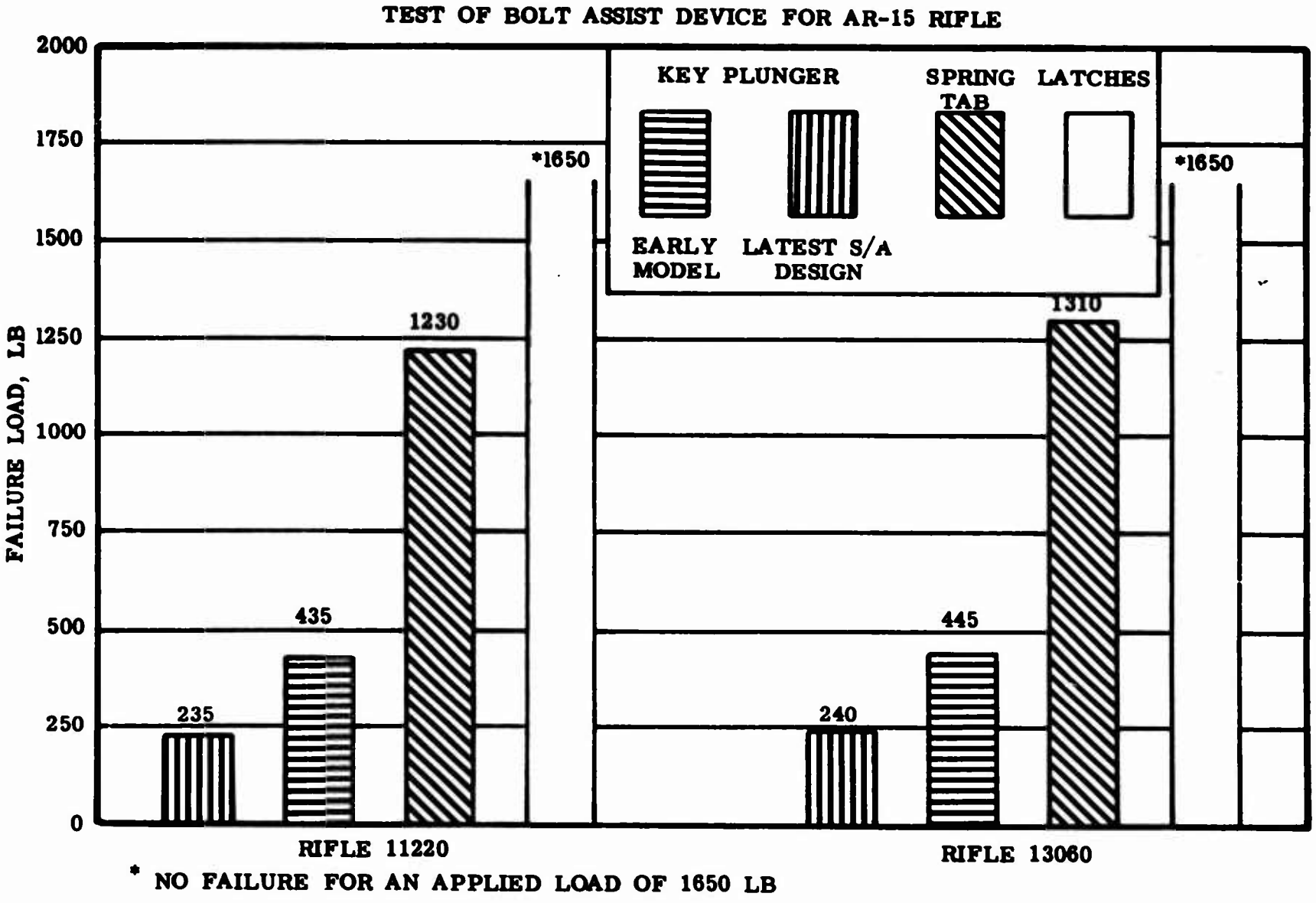

Figure 20: Test of Bolt Assist Device for AR15 Rifle.

2.6.3 Discussion. The destructive tests revealed that, in the event the charging handle spring is engaged with the carrier key plunger at the time of firing and the charging handle latches are engaged, the carrier key plunger will fail before the charging handle spring will fail, and the spring will fail before disengagement or failure of the charging handle latches will occur.

2.7 Measurement of Bolt Retraction and Closure Forces

2.7.1 Procedure. The maximum manual bolt retractive force exerted by individuals was determined by mounting a bracket at the gun muzzle. This bracket incorporated a spring scale anchored at the forward end. A wire passed from the scale, through the bore of the rifle, and was brazed to a shortened section of the firing pin housed in the bolt. The spring scale was capable of registering a maximum pull of 60 pounds at a rate of 10 pounds per inch of compression of the scale spring. The scale was mounted with a preload of 15 pounds when the bolt of the rifle was closed and locked. Using a standard rifle, retraction of the bolt was made by grasping the charging handle in the normal manner with thumb and forefinger. The rifle was supported by individuals by resting the butt of the stock against the hip and holding the forearm with the left hand (Figure 21).

The force required to extract and eject deformed cartridges was recorded. The charging handle of a standard AR15 rifle was drilled and tapped and a small bolt was assembled at the rear end. A wire was attached to the bolt at the rear of the charging handle and the opposite end of the wire was attached to the scale. The rifle was supported in a wooden cradle. Each deformed round was loaded singly in a magazine. The magazine was inserted in the rifle, and the bolt carrier was permitted to travel freely from the rearmost position, under energy of the compressed action spring. No attempt was made to fire any of the deformed rounds. In each instance the charging handle was unlatched, the handle of the scale was grasped and pulled rearward to record the force exerted.

The force required to clear the rifle of cases which failed to extract, after the rifle and ammunition were subjected to a mud test, was recorded similarly to that described for extraction and ejection of damaged cartridges (Figure 22).

Figure 21: Bolt Retractive Force Measurement. Note Spring Scale Mounted on Bracket Attached at Muzzle End of Rifle. Wire at Rear End of Scale Extended through Bore and Was Brazed to Shortened Firing Pin.

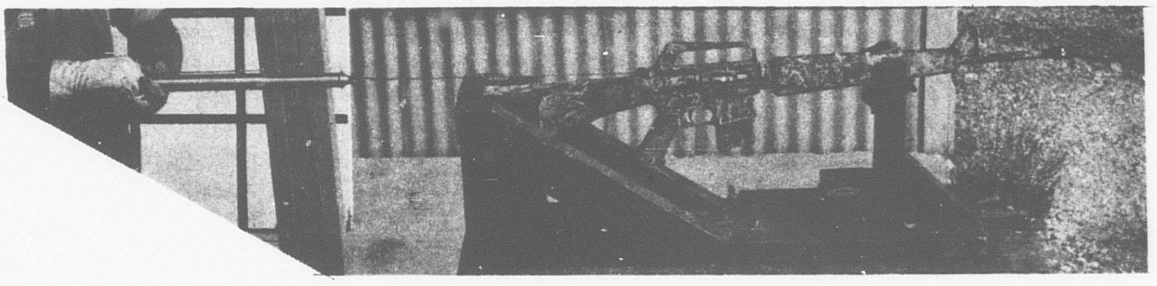

Figure 22: Spring Scale Attached to Rifle Charging Handle to Record Force Required to Extract and Eject Cartridge Case of Fired Round, after Rifle and Ammunition Were Submerged in Standard Mixture of Mud and Rifle Failed to Extract Fired Case.

Measurements were made to obtain an indication of the load transmitted by the bolt on chambered cartridges or cases when the butt of the stock is impacted on the ground. A standard AR15 rifle was modified by replacing the barrel with one having a chamber drilled and threaded to accommodate a transducer. The bolt was modified by enlarging the firing pin hole and substituting a threaded steel drawbar for the firing pin.

Assembly of the rifle and transducer consisted of pulling the wire leads from the transducer through the barrel bore until the transducer entered the modified barrel chamber and the connecting wires extended from the muzzle. The transducer was then screwed into the chamber flush with the rear of the barrel face. The bolt was then assembled to the receiver, and the bolt-transducer drawbar was screwed into the rear of the transducer. The receiver of the weapon was then closed, and the wire connections were made with the amplifier.

The force transducer, in addition to being externally threaded at the front and internally threaded at the rear, contained a center section reduced in diameter with a cross-sectional area of 0.02 square inch. Two Type C6 foil strain gages were attached to the thin-walled tube, one lateral and one transverse to the transducer axis. The circuit thus formed represented one half of a bridge circuit, the other half of the bridge being internal to the transducer amplifier.

In addition to the transducer amplifier, an oscillograph and a 12,000-pound capacity Universal test machine were used. Calibrations were made by adapting the rifle to the Universal test machine, and loads were applied in increments of 50 pounds to a maximum of 500 pounds. The load was applied to the bolt carrier of the rifle, with the barrel being retained. The instrumentation employed was thus calibrated as a system, before and after the test.

The force required to close and lock the bolt on deformed cartridges was measured, using a rifle equipped with a plunger bolt-closing device. A Universal test machine was used to apply an evenly increasing load. The loading rate was 0.3 inch per minute. A similar test was conducted with a standard AR15 rifle except that the load was applied directly to the bolt carrier, without benefit of the action spring. The force of the action spring was not determined.

Measurements were made of the average load applied to the head of the plunger bolt closing device by thumb pressure and by use of the heel of a hand. The average load applied to the pad of the double-latch charging handle bolt-assist device was also determined. All these measurements were recorded with the use of a Universal test machine, with the plunger and charging handle removed from the rifles and mounted in test fixtures emplaced on a Universal test machine (Figure 23).

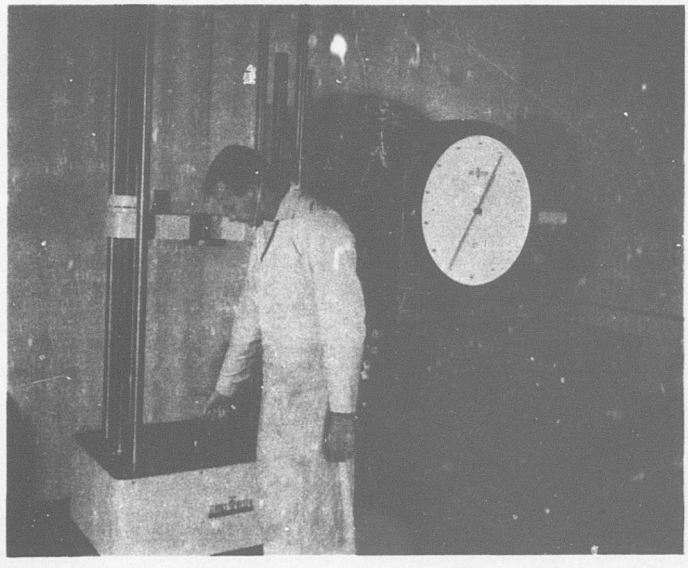

Figure 23: Recording Load Applied by Thumb Pressure on Head of Plunger-Type Bolt-Closing Device.

Typical examples of damaged cartridges used in the various tests conducted are shown in Figure 24.

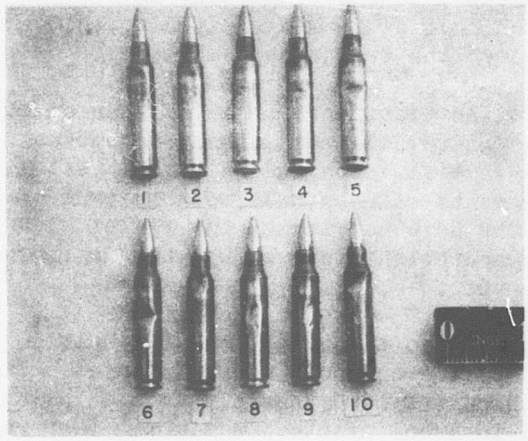

Figure 24: Typical Examples of Damaged Cartridge Cases Used in Extractive and Bolt Closure Force Measurements.

2.7.2 Results. The results are given in Tables VI, VII, VIII, IX, and X.

Table VI. Bolt Retractive Force

Maximum manual force exerted by use of forefinger and thumb on charging handle of standard AR15 rifle, in pounds.

Individual No.	Average of Five Trials, Spring Scale Measurement	Force Required to Compress Action Spring, Distance Handle Retracted	Total Force Applied to Charging Handle, Average of Five Trials
1	25	10	35
2	31	14	45
3	28	11	39
4	26	10	36
5	23	10	33
Average	27	11	38

Table VII. Extractive Force

Force exerted manually to extract and eject chambered deformed cartridges and fired cartridge cases which failed to extract during mud test. Measurements are given in pounds.

Rd No.	Force Registered on Spring Scale in Attempt to Extract and Eject Chambered Deformed Cartridge		Force Registered on Spring Scale in Attempt to Extract and Eject Cases Not Extracted during Firing	
	Extracted	Failed to Extract	Extracted	Failed to Extract
1	24		32	
2	15			60+
3	48		23	
4	14			60+
5		60+ (scale limit)		60+
6	34		48	
7	16			60+
8	25			60+
9	14			60+
10	26		27	
11				60+
12			44	
13			29	
14				60+
15			27	
16			22	
17			18	
18			19	
19			22	
Average	24		28	

Note: In all instances where extractions could not be made although loads in excess of 60 pounds were exerted, the rifle butt was impacted on the ground to remove the deformed cartridge or fired case.

Table VIII. Peak Force of Bolt Group on Chambered Cartridge or Fired Case When Butt of Stock Is Impacted on Ground

First Individual			Second Individual		
Trial	Peak Force, lb	Force on Charging Handle at Time of Impact, lb	Trial	Peak Force, lb	Force on Charging Handle at Time of Impact, lb
1	419	0	1	157	4.2
2	413	0	2	94	0
3	342	6.3	3	[a]685	0
4	[a]710	6.5	4	[a]660	0
5	[a]597	0	5	[a]670	0
			6	[a,b]730	0

Footnotes on following page.

[a]The design of the force transducer limited the load calibrations to 500 pounds. Since the indicated force in a number of the impacts exceeded this value, the linear capabilities of the transducer were exceeded. Therefore, all values above 500 pounds force should be considered only rough approximations. The rise and dwell time of the force peaks could not be determined reliably from the recording oscillograph record. The resolution of the oscillograph used was readable to 0.001 second of time. A force time estimate for 90% of the peak indicated force could reasonably be estimated to be about 0.0001 second.

[b]Off scale.

Table IX. Force Necessary to Close and Lock Bolt on Deformed Cartridges, pounds

Average Load Applied to Plunger Bolt Closing Device with Universal Test Machine to Chamber Ten Deformed Cartridges	Average Load Applied Directly to Bolt Carrier with Universal Test Machine to Chamber Ten Deformed Cartridges
23	21

Note: The force of the action spring on the bolt, when using the plunger bolt closing device, was not determined. When loads were applied directly to the rear of the carrier, the action spring was not used.

Table X. Maximum Manual Loads Applied to Plunger and Charging Handle Bolt Closing Devices

Average of five trials; measurements in pounds.

	Load Applied to Plunger Type Bolt Closing Device by		Load Applied to Pad of Double Latch Bolt Assist Device by Heel of Hand
Individual	Thumb	Heel of Hand	
1	75	91	129
2	51	111	165
3	71	149	204
4	41	92	106
5	57	130	170
Mean	59	115	155

Note: Bolt closing devices were removed from the rifles and mounted in fixtures emplaced on a Universal test machine.

2.7.3 Discussion. The results given in Tables VI and VII revealed that individuals were incapable of exerting sufficient force on the charging handle by use of a thumb and forefinger to remove some damaged rounds which were chambered and about 50% of the fired cases which failed to be extracted in the special mud test. However, damaged cartridges or fired cases which fail to extract can be expected to be removed by impacting the butt of the rifle on the ground and drawing rearward on the charging handle.

The results also revealed that individuals were capable of exerting far greater loads on the head of the plunger-type and charging-handle bolt-closing devices than is required to chamber cartridges damaged to the extent shown in Figure 24.

2.8 Firing of Plunger-Type Bolt-Closing Device Engaged with the Bolt at the Time of Firing.

During mud tests of rifles with the plunger-type bolt-closing devices, the plunger remained in the depressed position in a number of instances when the plunger was used to close the bolt. In each instance the plunger housing was sharply tapped with a piece of wood to return the plunger to normal protruded position. Firings were conducted with the plunger depressed and engaged with the bolt to determine if damage would occur.

2.8.1 Procedure. The plunger-type bolt-closing device was tightly taped in the fully depressed position with five layers of cloth adhesive tape (PPP-T-60 Amendment 3, Type 3, Class 1), which passed over the plunger and around the receiver. The tape was replaced after each of the four trials. Also, on one occasion the plunger was held in the fully depressed position by means of a spring-loaded battery connecting clip.

2.8.2 Results. On each occasion, the tape which was used to retain the plunger in the depressed position was torn loose and the plunger was returned to the normal extended position. The clip was projected rearward about 6 to 8 feet when the rifle was fired and the plunger was forced to the rear by the bolt. Examination of the rifle revealed no damage as the result of this investigation.

2.8.3 Discussion. If the AR15 rifle is fired with the plunger-type bolt-closing device in the depressed position, no damage to the rifle is expected to occur.

2.9 Magazine Performance

One magazine was provided with each rifle submitted for test. The magazine tube was fabricated of a nonferrous lightweight metal with vertically stamped reinforcement channels. Other magazines were also used in the tests and the material appeared to be the same; however, these magazines had both horizontal and vertical reinforcement channels.

2.9.1 Procedure. No performance data were acquired with the exception of the magazines received with rifles No. 013058 and 013351, the last two rifles received for test.

2.9.2 Results. The magazine provided with rifle No. 013351 was removed from test after 100 rounds of firing; 14 failures to feed and two "bolt override" feeding malfunctions occurred in a dust test, in firing rounds 81 to 100. The magazine supplied with rifle No. 013058 was removed during the cold test because it was suspected of causing failures to feed; the magazine is estimated to have been used in 180 to 380 rounds of firing.

PART III - APPENDICES

APPENDIX A

References

1. Hendricks, G. E. "Comparative Evaluation of AR15 and M14 Rifles." Aberdeen Proving Ground. Report No. DPS-799, December 1962.

2. Moore, L. F. "A Test of Rifle, Caliber .223, AR15." Aberdeen Proving Ground. Report DPS-96, October 1960.

3. Moore, L. F. "A Test of Rifle, Caliber .22, AR15; Rifle, Lightweight, Military, Caliber .224; and Pertinent Ammunition." Aberdeen Proving Ground. Project No. TS2-2015/57, January 1959.

4. Ordnance Proof Manual, OPM 20-05, Safety Evaluation of Small Arms, dated 19 December 1962.

5. Ordnance Proof Manual, OPM 20-20, Hand and Shoulder Weapons, dated 9 June 1958.

APPENDIX B

Correspondence

HEADQUARTERS
U.S. ARMY TEST AND EVALUATION COMMAND
ABERDEEN PROVING GROUND, MARYLAND

AMSTE-BC 19 JUL 1963

SUBJECT: Test of Bolt Assist Device, AR-15 Rifle

TO: Commanding Officer
Aberdeen Proving Ground
ATTN: STEAP-DS
Aberdeen Proving Ground, Maryland

1. References:

a. Proposed Test Plan for Evaluation of the Bolt Assist Device on AR-15 (Inclosure 1).

b. Letter from Commanding General, U. S. Army Test and Evaluation Command to Commanding General, U. S. Army Weapons Command, subject: "Initial Comment on Proposed Bolt Modifications AR 15 Rifle" (Inclosure 2).

2. The U. S. Army Test and Evaluation Command has been requested to evaluate the Modified AR-15 cocking handle incorporating a bolt assist device. The modified rifle was delivered to this command by a Springfield Armory representative on 17 July 1963 with subsequent delivery to your agency on same date.

3. A proposed test plan prepared by Springfield Armory accompanied the delivery of the modified rifle. This plan will be utilized by the Armory in their testing of the modified cocking handle and is suggested as a plan of test that, if pertinent, may be utilized by your agency. In addition to the proposed test, a modified sustained fire test is required as a final phase to determine the effect of heating on the camming spring and bolt projection. It is directed that any comments and/or suggested additional tests be forwarded this headquarters without delay. This command has been informed by telephone that 8,000 rounds of ammunition have been shipped to support this test.

4. Additional modified rifles scheduled to be submitted for test are: one (1) fabricated by Springfield Armory during week of 12 August 1963, and two (2) fabricated by Manufacturing Company during week of 19 August 1963. Lt Col Yount has been informed by this command that 25,000 rounds will be needed to support tests at both the Infantry Board and your agency.

TEC # 8-3-0030-06-F

AMSTE-BC
SUBJECT: Test of Bolt Assist Device, AR-15 Rifle

19 JUL 1963

5. All evaluations by this command must be completed and results compiled in a manner sufficient for presentation to U. S. Army Weapons Command on 10 September 1963. Your agency will be required to send representatives.

6. This activity is designated as a Product Improvement Test and USATECOM Project Nr 8-3-0030-06F has been assigned. This number will also apply to future tests scheduled for August. In the event of conflict, priority will be such as to take precedence over other activities. Where doubt exists, this headquarters should be contacted for direction. It is emphasized that Board firing evaluation of the first rifle is awaiting your safety evaluation as outlined in reference "b", and that this must be completed by 26 July 1963.

FOR THE COMMANDER:

1 & 2 Incls
as

EARL A. HICKS, JR
Lt. Col, Arty
Asst Admin Officer

COPY/mvr

PROPOSED TEST FOR AR-15 BOLT ASSIST DEVICE

I. INTRODUCTION

1. The bolt assist devices incorporated in the modified cocking handles for AR-15 Rifles can not be certified safe until the devices have successfully completed extensive tests.

2. The purpose of the following test is to give the bolt assist device the most severe test practicable to determine:

a. if the device will overcome any malfunction consisting of the bolt failing to close.

b. if any undue safety hazards exist resulting from the modified cocking handle.

3. Caution:

In tests wherein live ammunition is used, personnel must be protected from injury that could result from the bolt assist device failure to disengage or move clear of the bolt carrier before a round is fired.

II. TEST PROCEDURE

1. Special Items Required:

a. Shortened Drive Spring - A standard drive spring with coils removed so that the bolt will consistently fail to close during normal operation of the rifle.

b. Empty Cased Ammunition - Ammunition from which the propellant powder has been removed but having a primer.

c. Use of fully loaded ammunition requires a device to push the cocking handle forward when the bolt assist device and bolt carrier are engaged. The device should be designed to protect the operator if the bolt assist device has not disengaged when the round fires. The use of a shield providing protection to personnel is recommended.

2. Preliminary Inspection

a. Inspect the bolt assist device:

(1) for proper operation

(2) with a magnetic inspection process to detect cracks if present.

PROPOSED TEST FOR AR-15 BOLT ASSIST DEVICE (Cont'd)

(3) accurately determine the free height of

(a) the leaf spring above the cocking handle body in Type I bolt assist devices.

3. After-Test Inspection

a. Inspect the interior of the receiver for wear and inspect the components of the modified cocking handle:

(1) for wear

(2) for formation of burrs

Note: Do not remove any burrs that may develop during the test.

(3) with a magnetic inspection process to detect cracks.

(4) accurately determine the free height of

(a) the leaf spring above the cocking handle body in Type I bolt assist devices.

4. First Function Test

a. Replace the drive spring with a shortened spring that will result in consistent failure of the bolt to close in normal use of the rifle.

b. Feed 500 rounds of empty-cased ammunition using the bolt assist device to complete the feeding stroke.

Note: Record premature firing of primers.

c. Perform the after-test inspection.

5. Dust Test

a. Lightly oil the rifle and install the shortened drive spring.

b. Tape the muzzle shut, place a dummy round in the chamber, close the action, but leave the dust cover open and do not assemble a magazine to the rifle.

c. Place the weapon in a dust box and subject it to dusting for

(1) one minute in an upright position.

(2) one minute in an inverted position.

d. Attempt to clean the rifle by wiping with hands, jarring the rifle and by blowing at congested areas.

e. Remove the tape and dummy round and fire 50 rounds of ammunition. Use the bolt assist device, remotely operated to assist the feeding of each round.

f. Repeat Steps 5b through 5e inclusive.

g. Repeat Steps 5b through 5e inclusive.

h. Perform the after-test inspection.

6. Muddy Water Test

a. Lightly lubricate the rifle.

b. Apply authorized grease to all bearing surfaces.

c. Tape the muzzle shut, place a dummy round in the chamber, close the action but leave the dust cover open and do not assemble a magazine.

d. Submerge the rifle in muddy water for 15 seconds.

e. Allow excess water to drain off the rifle, remove the tape and dummy round, and wipe the bore.

f. Fire 50 rounds of ammunition using the bolt assist device, remotely operated, to complete the feeding stroke.

g. Repeat Steps 6c through 6f inclusive.

h. Repeat Steps 6c through 6f inclusive.

i. Perform the after-test inspection.

7. Dry Test

a. Completely clean and degrease the rifle.

b. Fire 150 rounds of ammunition using the bolt assist device, remotely operated to assist the feeding stroke.

c. Perform the after-test inspection.

COPY/mvr

PROPOSED TEST FOR AR-15 BOLT ASSIST DEVICE (cont'd)

8. Cold Test

a. Completely clean the rifle and lubricate with authorized lubricant for sub-zero temperature use.

b. Condition the rifle for three hours at -65°F.

c. Fire 250 rounds of ammunition using the bolt assist device, remotely operated to complete the feeding stroke.

d. Remove the rifle from the -65°F temperature to normal room temperature for twenty minutes allowing condensation to occur.

e. Return the rifle to the cold chamber and condition at -65°F for one hour.

f. Fire 250 rounds of ammunition using the bolt assist device remotely operated to complete the feeding stroke.

g. Perform the after-test inspection.

9. Endurance

a. Completely clean and lightly lubricate the rifle and install a standard drive spring.

b. Fire 4000 rounds* alternating the type of fire as follows:

(1) 100 rounds of semiautomatic fire.

(2) 100 rounds of spasmodic fire.

(3) 100 rounds of automatic fire.

c. Perform the after-test inspection.

* Assist the feeding by remote operation of the bolt assist device whenever the bolt fails to close.

10. Second Function Test

a. Completely clean and lightly lubricate the weapon.

b. Repeat Steps 4a, 4b, 4c.

COPY/mvr

PROPOSED TEST FOR AR-15 BOLT ASSIST DEVICE (Cont'd)

11. Timing Test

a. Completely clean and lubricate the weapon.

b. Install the shortened drive spring and set the selector for automatic fire.

c. Assist the feeding of 50 rounds of fully loaded ammunition by remotely operating the bolt assist device to complete the feeding stroke while holding the trigger depressed with a lanyard.

d. Perform the after-test inspection.

12. Destructive Test

a. Clean and lightly lubricate the weapon.

b. Install the standard drive spring.

c. Obtain a time-displacement curve of the cocking handle and stock when a round is fired with a lanyard when the operating handle is latched and the bolt assist device obstructed or rendered inoperative so that it does not disengage the bolt carrier when the action is closed and the handle is latched in firing position.

d. Perform the after-test inspection.

TELEPHONE OR VERBAL CONVERSATION RECORD
(AR 340-15)

DATE: 24 Jul 63

[redacted]. SUBJECT OF CONVERSATION: Test of Bolt Assist Device, AR 15

GRADE:

SERVICE NUMBER:

HOME ADDRESS OR ORGANIZATION AND STATION:

PERSON CALLING	OFFICE OR RELATIONSHIP	TELEPHONE NUMBER
H. A. Noble	Actg Assoc Dir, D&PS	47284

INFORMATION OR ACTION SOUGHT

Mr. Noble stated that for purposes of a safety release, the following immediate tests are planned:

a. Mud.

b. Rain.

c. Unlubricated.

d. Cold chamber operations involving repeated cycling of the mechanism.

Mr. Morrow stated this was agreeable. Funds currently remaining from "Comparative Evaluation of AR 15 and M14 rifles" are authorized for use in this test.

[redacted]

The testing period was estimated as five working days. The project manager's expressed urgency associated with this program makesweek-end activity advisable so that an early decision on which to base continuation of this effort at D&PS and USAIB can be made.

Copies furnished:
STEAP-DS (Mr. Noble)
STEAP-DS (Mr. Dollney)

CLERK TAKING CALL	TIME	SEARCHED BY	TIME	ANSWERED BY	TIME

DATE: 24 Jul 63

SIGNATURE AND TITLE OF PERSON CONTACTING: GOODWIN MORROW, Inf Mat Test, USATECOM

DA FORM 1 FEB 58 751 REPLACES EDITION OF 1 OCT 51

* U S GOVERNMENT PRINTING OFFICE 1958 O—457619

COPY/mvr

TELEPHONE OR VERBAL CONVERSATION RECORD
(AR 340-15)

DATE: 24 Jul 63

LAST NAME · FIRST NAME · MIDDLE INITIAL OR, SUBJECT OF CONVERSATION	GRADE	SERVICE NUMBER
H. A. Noble		

HOME ADDRESS OR ORGANIZATION AND STATION
Acting Associate Director, DGPS

PERSON CALLING	OFFICE OR RELATIONSHIP	TELEPHONE NUMBER
Mr. G. Morrow	USATECOM	

INFORMATION OR ACTION SOUGHT

SUBJECT: Test of AR 15 Bolt Closing Device

Subject to confirmation of this conversation by USATECOM I agreed that we would (a) initiate the subject program using funds available from the previous AR 15 M14 program, (b) for safety evaluation, conduct adverse conditions tests and low temperature tests using three cycles of each since we have only one weapon for test. We will conduct special low temperature firings operating the bolt closing device to simulate life time operations, (c) overtime will be used to complete the tests as soon as reasonable.

I estimated the firing time to be 5 days assuming scheduling permits initiation of the operations on Thursday 25 July. We expect to finish on Monday, 29 July.

INFORMATION GIVEN OR ACTION TAKEN

Action may be initiated by Engrg Testing and PPO on this telephone conversation report pending receipt of documentation from USATECOM.

Copy furnished:

USATECOM, Attn: AMSTE-BC, Mr. Morrow
PPO, DGPS
Engrg Testing, DGPS
Ing & Acft Wpns Div, DGPS

CLERK TAKING CALL	TIME	SEARCHED BY	TIME	ANSWERED BY	TIME

DATE	SIGNATURE OF PERSON DIRECTING ACTION
24 Jul 63	H. A. NOBLE

DA FORM 1 FEB 55 751 REPLACES EDITION OF 1 OCT 51.

U. S. GOVERNMENT PRINTING OFFICE 1956 O—457819

AMSTE-BC(19 Aug 63) 1st Ind
SUBJECT: Test of Bolt Assist Device, AR 15 Rifle, USATECOM Project Nr 8-3-0030-06F

Headquarters, United States Army Test and Evaluation Command, Aberdeen Proving Ground, Maryland 28 AUG 1963

TO: Commanding Officer, Aberdeen Proving Ground, ATTN: STEAP-DS-TI, Aberdeen Proving Ground, Maryland

This headquarters concurs with the instructions and actions taken by Development and Proof Services as stated in subject letter.

FOR THE COMMANDER:

JOHN W. RODGERS
Colonel, GS
C, Admin Ofc

U. S. ARMY
DEVELOPMENT AND PROOF SERVICES
ABERDEEN PROVING GROUND
MARYLAND

Mr SDoilney/jp/32289

IN REPLY REFER TO

STEAP-DS-TI

AUG 19 1963

SUBJECT: Test of Bolt Assist Device, AR 15 Rifle, USATECOM Project Nr 8-3-0030-06F

TO: Commanding General
U. S. Army Test and Evaluation Command
ATTN: AMSTE-BC
Aberdeen Proving Ground, Maryland

1. References:

a. USATECOM letter, same subject as above, dated 19 July 1963, to APG, Attn: STEAP-DS.

b. USATECOM Telephone Conversation Record dated 24 July 1963, signed by Goodwin Morrow.

2. The referenced letter authorized testing of a modified AR-15 rifle delivered to D&PS in July and also two additional modified AR-15 rifles which were scheduled for delivery the week of 12 August 1963.

3. The referenced telephone conversation record outlines a safety evaluation plan for test of the first rifle delivered. The tests authorized in the telephone record were as follows: mud, rain, unlubricated and cold (-65°F) tests. By verbal agreement with USATECOM a dust test was substituted for the rain test, and three cycles of the unlubricated, dust, and mud tests were authorized. Also it was agreed that the weapon would be cycled manually 500 times under cold conditions (-65°F), using standard cartridges, to accomplish the number of hand charging operations required in 10,000 rounds of firing, based on the necessity of charging the first round of each magazine used.

STEAP-DS-TI
SUBJECT: Test of Bolt Assist Device, AR 15 Rifle, USATECOM Project Nr 8-3-0030-06F AUG 19 1963

4. Since receiving two additional modified rifles verbal instruction was received from USATECOM that the test plan would be similar to that employed in test of the first rifle. In addition, following completion of the firing, destructive tests would be conducted by the D&PS Physical Test Laboratory to determine the shear strength of the bolt plunger pin and the tensile strength of the spring portion of the bolt assist device. Also, the bolt assist device latching would be tested by applying a load 25 per cent in excess of the maximum load which caused failure of the other components tested. The shear strength of the bolt plunger pins assembled in the test rifles and two pins of later design will be determined. No other testing of the three rifles or components is contemplated.

5. The telephone conversation record authorized use of funds remaining from the "Comparative Evaluation of AR-15 and M14 Rifles" program, to conduct tests of the first rifle received. Since completion of test of the first rifle, $4500.00 was received from Springfield Armory to cover the cost of testing; the D&PS Program Planning Office requested an additional $3500.00 to cover the total costs of the program. However, until the additional funds are received, D&PS will continue to use the funds originally authorized by USATECOM. Later, all the costs will be transferred to the Springfield Armory funding documents.

6. Confirmation of the above instructions and concurrence with the D&PS actions outlined is requested.

for W. G. North

EUGENE C. BARBERO
Colonel, OrdCorps
Director

2

HEADQUARTERS
U.S. ARMY TEST AND EVALUATION COMMAND
ABERDEEN PROVING GROUND, MARYLAND

AMSTE-BC

28 AUG 1963

SUBJECT: AR-15 Rifle

TO: Commanding Officer
Aberdeen Proving Ground
ATTN: STEAP-DS (Mr. Noble)
Aberdeen Proving Ground, Maryland

1. Confirming verbal instructions G. Morrow, USATECOM to Mr. Doilney, 28 Aug 63, it is requested that the effect of a cook-off after sustained automatic fire with the bolt unlocked be determined using the original AR-15 single latch design without bolt assist device. The least serviceable weapon available should be utilized, since the test is destructive in nature.

2. It is desirable that the cook-off be associated with the latest magazine design as supplied with the double latch version with bolt assist, however, only two magazines (aluminum) were supplied to D&PS and these may not be identifiable from other aluminum magazines with different characteristics remaining from previous tests. In addition, two magazines are inadequate for sustained fire activity. In lieu of this, deformation of a cartridge in a manner to prevent bolt closure can be substituted.

3. The rifle is to be heated to cook-off levels by rapid firing of approximately 160 rounds before the deformed round is inserted. An indicator (celotex or equivalent) of charging handle rearward force is to be fixed at a position corresponding to a gunners cheek. Color motion pictures are to be taken of the cook-off.

4. The weapon is to be mounted in a bench rest and cautions normally exercised for sustained automatic fire are pertinent, i.e., face mask, goggles, heavy gloves, overgarments and armor vest. Rupture or splitting of the receiver, blowout of the magazine and movement of the charging handle to the rear must be assumed.

5. Two cook-off failures of this nature have been encountered. Firing was from the hip with personnel exposed and no injuries resulted.

FOR THE COMMANDER:

Copy furnished:
CO, APG, ATTN: STEAP-DS-TI
(Mr. Doilney)

JOHN W. RODGERS
Colonel GS
C, Admin Div

HEADQUARTERS
U.S. ARMY TEST AND EVALUATION COMMAND
ABERDEEN PROVING GROUND, MARYLAND

AMSTE-BC

14 SEP 1963

SUBJECT: AR-15 Rifle, USATECOM Project No. 8-3-0030-06F

TO: Commanding Officer
Aberdeen Proving Ground
ATTN: STEAP-DS (Mr. Noble)
Aberdeen Proving Ground, Maryland

1. Reference letter AMSTE-BC to CO, APG, ATTN: STEAP-DS, 28 Aug 63, subject as above.

2. Referenced letter requested cook-off tests of original version of AR-15 with single latch and without Bolt Assist Device. These tests were conducted on 29 August 1963 and were witnessed by representatives of this headquarters.

3. Lt Col Yount, USAMECOM, was informally apprised of the results. He has expedited a modification to the double latch version with Bolt Assist which he feels will prevent the charging handle from moving to the rear in the event of a cook-off with the bolt unlatched. This modification is being hand carried to Aberdeen Proving Ground by a Mr. Lorenzon from the USA Weapons Command on 2 September 1963.

4. It is directed that a cook-off test be conducted on this modification in the same manner as that imposed on 29 August 1963. The test is to be run on 3 September in the presence of Mr. Lorenzon. Photographs and details of the modification are to be recorded prior to testing.

FOR THE COMMANDER:

John W. Rodgers

JOHN W. RODGERS
Colonel GS
C, Admin Div

Copy furnished:
STEAP-DS (Mr. Doilney)

HEADQUARTERS
U.S. ARMY TEST AND EVALUATION COMMAND
ABERDEEN PROVING GROUND, MARYLAND

AMSTE-BC

9 SEP 1963

SUBJECT: Tests to Determine Extraction Force Measurements in Removal of AR-15 Cartridge Cases

TO: Commanding Officer
Aberdeen Proving Ground
ATTN: STEAP-DS
Aberdeen Proving Ground, Maryland

1. The U. S. Army Materiel Command has verbally requested this command to conduct tests on the standard AR-15 Rifle to determine forces under various conditions necessary to extract cartridge cases from the chamber of the rifle.

2. It is directed that Development and Proof Services conduct the following tests and measure the extraction forces necessary to extract cartridge cases that cannot be removed by normal extraction methods:

a. Difficult extractions encountered during mud tests.

b. Difficult extractions encountered during dust tests.

c. Difficult extractions encountered by imposing dents in live ammunition - chambering and firing - then extraction.

d. Utilizing different personnel to measure the shocking force and the number of repetitions necessary for the extraction of a lodged case in chamber while pounding butt of rifle and simultaneously exerting a force on the charging handle by hand.

e. Determine the force that different individuals can exert by holding the fore stock of the rifle with one hand and exerting a rearward force by grasping the charging handle with the other hand.

3. For comparison determine the force necessary for a normal extraction under normal conditions.

AMSTE-BC

8 SEP 1969

SUBJECT: Tests to Determine Extraction Force Measurements in Removal of AR-15 Cartridge Cases

4. If funds currently being utilized for this test are inadequate, utilization of funds remaining from the "Comparative Evaluation of AR-15 and M-14 Rifles" is authorized.

FOR THE COMMANDER:

JOHN W. RODGERS
Colonel, GS
C, Admin Ofc

Copy furnished:
STEAP-DS (Mr. Doilney)

8 SEP 1959

AMSTE-BC

SUBJECT: Tests to Determine Extraction Force Measurements in Removal of AR-15 Cartridge Cases

4. If funds currently being utilized for this test are inadequate, utilization of funds remaining from the "Comparative Evaluation of AR-15 and M-14 Rifles" is authorized.

FOR THE COMMANDER:

JOHN W. RODGERS
Colonel, GS
C, Admin Ofc

Copy furnished:
STEAP-DS (Mr. Doilney)

HEADQUARTERS
U.S. ARMY TEST AND EVALUATION COMMAND
ABERDEEN PROVING GROUND, MARYLAND 21005

AMSTE-BC

16 SEP 1963

SUBJECT: Modified Bolt Assist Device

TO: Commanding Officer
Aberdeen Proving Ground
ATTN: STEAP-DS
Aberdeen Proving Ground, Md 21005

1. Reference First Letter Report on Test of Bolt Closing Device for AR-15 Rifle from STEAP-DS to AMSTE-BC.

2. Your agency is presently engaged in testing modifications to the AR-15 Rifle to evaluate the proposed improvements for closing the bolt. Two models have been tested with a third configuration delivered to your agency by Springfield Armory on 10 Sep 63.

3. It is directed that tests be conducted in approximately the same manner as tests on the first model that included adverse and climatic conditions, unlubricated, etc.

4. After completion of tests, evaluate the damage that can be expected if the pin of the closing device does not retract but remains engaged in the ratchet slots of the bolt. This may be accomplished by removal of the retention spring or exerting sufficient force on the protruding button to produce engagement.

5. If time does not allow for this test to be included in the final report, preparation for comments at the proposed meeting is directed.

FOR THE COMMANDER:

[redacted]
GS
Executive Ofc

8-3-0030-06-F

APPENDIX C

Function Report

Cook-Off Test

Time	No. Rds Fired	Total No. of Rds Fired on Test	Type Fire	Function	Remarks
		Rifle, Caliber .223, AR-15, No. 008271 28 August 1963			
		The rifle was disassembled, cleaned and lubricated with general purpose MIL-L-644B oil. The disconnector was broken. It was not replaced. The rifle was equipped with the standard aluminum charging handle. The stock was replaced with a steel butt plate and the rifle was supported in a wooden cradle.			
		Rifle, Caliber .223, AR-15, No. 008679 29 August 1963 Cartridge, ball, caliber .223, lot 5024 (Z15M)			
		Nine magazines were each loaded with 20 rounds and the rounds fired automatically in an attempt to insure that no malfunctions attributable to defective magazines would occur when the test rifle (No. 008271) was fired in the unlocked-bolt cook-off test. Rifle No. 008271 was not available for this firing.			
0849	180	180	A		The bolt failed to remain to the rear on five occasions after the last round in a magazine was fired.
		Rifle, Caliber .223, AR-15, No. 008271			
		The rifle was supported in a wooden cradle. Nine selected magazines were each loaded with 20 rounds. The case neck of a round was deformed with the aid of pliers. The deformed round would permit the bolt and bolt carrier to move forward until the locking lugs of the bolt reached the engagement position but not locked.			
		The deformed round was loaded singly in a separate magazine.			
0942	160	160	A		Four failures-to-feed occurred when the nose of the bullet stubbed as it was stripped from the magazine. The bolt failed to remain to the rear on eight occasions after the last round in a magazine was fired.
		The velocity measuring device was positioned on the lower receiver extension and the deformed round was loaded 89 seconds after the first round was fired. The charging handle was in the locked position. The round did not cook-off.			

Cook-Off Test (Cont'd)

Time	No. Rds Fired	Total No. of Rds Fired on Test	Type Fire	Function	Remarks

It was noted that two of the magazines did not have the horizontal reinforcement channels that were stamped in the sides of the other magazines. Three of the four failures-to-feed had occurred when using these two magazines and these magazines were replaced with magazines with the horizontal reinforcement channels.

Nine selected magazines were each loaded with 20 rounds. One magazine was singly loaded with the deformed round.

1021	177	337	A		The bolt overrode the base of the eighteenth round in one magazine. The magazine was removed and no attempt was made to clear it or to fire the remaining three rounds. The bolt failed to remain to the rear on seven occasions after the last round in a magazine was fired.

The velocity measuring device was installed and the deformed round was loaded 45 seconds after the first round was fired. The charging handle was in the locked position. The round cooked-off in 17 seconds.

Examination of the rifle disclosed that the cartridge case had ruptured at the head, and 0.8 inch forward of the rim. The primer of the ruptured case was punctured by the firing pin. The magazine floor plate, magazine spring and magazine follower were blown out of the magazine. The magazine walls were bulged. The bolt carrier was jammed in the receiver 2 inches rearward from the closed position. The bolt carrier could not be fully closed or retracted. The charging handle was in the locked position but could be partially retracted. The starting contact on the velocity measuring device had been positioned 0.020 inch to the rear of the charging handle. It registered a start on the counter chronograph. The lower receiver extension was removed and the portion of the bolt carrier extending rearward from the receiver was removed with a hacksaw. The portion of the bolt carrier remaining in the receiver was forced forward to permit the receiver halves to pivot and the bolt carrier forced rearward and out of the upper receiver. Examination of the bolt carrier assembly disclosed that the firing pin retaining pin was broken, the bolt cam pin was broken and jammed against the bolt carrier key which was bent upward. The bolt cam pin had gouged the bolt cam pin recess area in the upper receiver and had jammed against the receiver walls. The charging handle was not damaged.

Cook-Off Test (Cont'd)

Time	No. Rds Fired	Total No. of Rds Fired on Test	Type Fire	Function	Remarks
		Rifle, Caliber .223, AR-15, No. 012548 3 September 1963 Cartridge, ball, caliber .223, lot 5024 (Z16M)			
		The rifle was disassembled, cleaned and lubricated with general purpose MIL-L-644B oil. The safety detent was missing and the safety detent from another rifle was installed. The rifle was equipped with a steel charging handle with a modified bolt assist device. The stock was removed and a steel butt plate was attached to the lower receiver extension. The rifle was supported in a wooden cradle. Nine magazines were each loaded with 20 rounds. The case neck of a round was deformed with the aid of pliers. The deformed round would permit the bolt and bolt carrier to move forward until the locking lugs of the bolt reached the engagement position but not locked. The deformed round was loaded in a magazine previously loaded with 19 rounds.			
1401	180	180	A		The bolt failed to remain to the rear on four occasions after the last round in a magazine was fired.
		The magazine loaded with 19 rounds and the deformed round was installed. The deformed round was loaded 51 seconds after the first round was fired. The velocity and impact force measuring device, used on 29 August 1963, was positioned on the lower receiver extension. The charging handle was in the locked position. The deformed round cooked-off in 43 seconds.			
		Examination of the rifle disclosed that the cartridge case had ruptured at the head, and 0.8 inch forward of the rim. The magazine floor plate, magazine spring and magazine follower were blown out of the magazine along with the 19 live rounds in the magazine. The magazine walls were bulged. The charging handle was in the locked position. The top of the upper receiver was cracked through 5 inches of its length. The bolt was jammed against a portion of the ruptured case but the bolt carrier was retracted, using the charging handle, and the rifle was cleared. The rifle appeared to function properly.			
		The rifle was disassembled and inspected. The mouth of the tube of the bolt carrier key was damaged in a manner that indicated that it had contacted and had not been in line with the mouth of the gas tube pipe. It was also noted that the bolt carrier key plunger had sheared. Before firing commenced, the deformed round was manually chambered to insure that, in the attempted cook-off, the bolt would be permitted to close but not lock and that the charging handle could be locked. Force was applied to the charging handle to move it into the locked position after the deformed round was chambered in this trial. This force could have been sufficient to shear the bolt carrier key plunger.			

AD_____Accession No._____
D&PS, Aberdeen Proving Ground, Maryland
USATECOM PROJECT NO. 8-3-0030-06F, PRODUCT IMPROVEMENT TEST OF BOLT ASSIST DEVICES FOR RIFLE, CALIBER .223, AR15
A. Wilson

Report No. DPS-1120, November 1963
AMCMS Code No. 5522.11.458
Unclassified Report

The charging handle bolt assist device for the caliber 223 AR15 rifle and a plunger-type bolt were evaluated for effectiveness in manual extract and bolt closure operations. They were tested for operation under adverse conditions and other special tests were conducted. Only the bolt device was effective. The handle did not operate satisfactorily and it is recommended that it not be adopted.

AD_____Accession No._____
D&PS, Aberdeen Proving Ground, Maryland
USATECOM PROJECT NO. 8-3-0030-06F, PRODUCT IMPROVEMENT TEST OF BOLT ASSIST DEVICES FOR RIFLE, CALIBER .223, AR15
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D&PS, Aberdeen Proving Ground, Maryland
USATECOM PROJECT NO. 8-3-0030-06F, PROD-
UCT IMPROVEMENT TEST OF BOLT ASSIST DE-
VICES FOR RIFLE, CALIBER .223, AR15
A. Wilson

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